The North Pickering Project

SERVICES, UTILITIES, and COMMUNICATIONS

plantown
consultants limited

INTERIM REPORT

This report was prepared as background material in the planning of North Pickering Planning Area and does not necessarily constitute a recommendation of the North Pickering Project nor approval of the Government of Ontario.

INTERIM REPORT on: SERVICES, UTILITIES, and COMMUNICATIONS for: THE NORTH PICKERING PROJECT

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October 1974

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1. INTRODUCTION - STATUS REPORT

This report covers work carried out in Phase I of the overall plan for development study, covering generally the 'Basis for the Plan'. The first phase represents approximately 1/3 of the study program.

Activities undertaken during Phase I included preparation of Discussion Papers 1 and 2, covering 'Initial Assumptions and Issues' and 'Establishing Goals and Objectives', and input to Disucssion Papers 3 and 4 on Physical Design Concepts and Evaluation of Preliminary Concepts. The work generally involved data collection and review and the preparation of a broad base for more detailed study in developing selected alternative plans in Phase II.

The work program incorporated regular meetings of the Plantown Co-ordinating Committee and the 'physical design' team. Specific to the 'services' co-ordination area, the program involved several meetings of the North Pickering Utilities Co-ordinating Committee, comprising representatives from Provincial ministries, local municipal governments, utility companies and the Toronto Area Airport Project. Meetings were also held with the Sub-committee on Technological Innovation. An initial public participation meeting was held with a special interest group relating to services and utilities.

The major work function during Phase I involved studies carried out to summarize the 'State of the Art' of the various service and utility fields to determine the best servicing systems for the new community and the applicability of technological innovations.

Several areas of interest which were not fully dealt with during the first phase included an assessment of the hydrologic model being developed by Dr. S. Solomon, and the establishment of working relationships with existing provincial task forces on Energy, Solid Waste and Housing.

Work on the type and level of service for the various systems to be provided in the basic community infrastructure carries over into Phase II work on the evaluation of alternative concepts.

2. SUMMARY OF PHASE I STUDY

2.1 Regional Networks

Regional systems for water supply and sanitary waste disposal are proposed by the Ministry of the Environment, adjacent to and through the community.

The project site is reasonably well drained by natural water-courses, but environmental considerations may necessitate a degree of relatively innovative storm water management.

Regional power and communications networks exist proximate to the project site and offer ready opportunities for community development.

2.2 Community Services and Utilities

A review of the current 'State of the Art' of service and utility systems indicates that while the opportunity exists to incorporate a wide variety of technologically innovative concepts, many of the more interesting innovations would only apply to areas of relatively high density to be economically feasible.

Service, utility and communications networks will be provided in accordance with high current standards, taking advantage of feasible innovations where possible.

Overall construction economies can be achieved by providing residential services in accordance with the standards and criteria outlined in the recently published Ontario Housing Advisory Committee guidelines.

Depending upon the methods adopted for solid waste collection and disposal, consideration may be given to the use of garbage grinders in the homes to dispose of the putrescible portion of household solid wastes. This would have an impact on the design criteria for the proposed regional sewage treatment plant.

The handling of storm water runoff will be reviewed with a view to minimizing peak runoff rates and minimizing the pollution load in the runoff water.

The variety of methods available for dealing with solid waste collection, processing and disposal will be considered in realtion to municipal, regional, and provincial policies and proposals.

Methods of water conservation and re-use, except as related to industrial uses, are probably not justified for the new community except possibly in conjunction with other factors

related either to quite dense development, or on the other hand, an area of relatively isolated development. Conservation of water can lead directly to conservation of energy since studies have indicated that a significant percentage of energy produced is used to supply water to industry and the public.

New communications uses can be readily provided with traditional communications systems and facilities, supplemented by currently developing concepts. A variety of recently developing uses are expected to be provided in the new community.

Innovative developments in energy systems can be accommodated with little variation to traditional methods in the broad sense. In the energy field the innovations tend to be more in the area of new types of equipment and materials.

Proposals for conservation of energy are similar to the above comments for communications and energy in that the various principles for conservation of energy can be applied to traditional systems, and will probably apply more to type of building construction and proposed municipal legislation than to the provision of service and utility infrastructure. Some servicing innovations particularly those which have been developed to save capital costs, such as pressure and vacuum sewer systems or direct pumping of water supply systems, tend to require more energy than the more conventional systems.

Common location of services and utilities relates to multi-use utility corridors on the broad scale through traditional location on the road rights-of-way to utility tunnels at the local scale. Utility tunnels are only economically feasible for dense, compact urban development. The approach to systems location will relate mainly to co-ordination of traditional utility locations and the use of common trenching for compatible services.

Opportunities exist for improvement in multi-utility co-ordination and features such as automatic meter reading are applicable to the community. The subject is under active study by the Sub-Committee on Technological Innovation.

In consideration of the systems interface and interaction, it is clear that further study activities must be directed to resolving the compatibility of overall community systems.

Throughout the planning process, the evaluation of specific alternate servicing, utility or communication concepts, particularly those of an innovative nature, can conflict or interact with other servicing, utility or communication areas and facets of other co-ordination areas. The other co-ordination study areas most involved will be transportation and environment.

Just how the concepts in one areas may affect other considerations must be analyzed, the advantages and disadvantages established, tradeoffs made and the most feasible overall system selected.

At this stage in the planning process some possible areas of mutual involvement can be identified. No doubt others will become evident as the conceptual plans are formulated in more detail.

Examples are as follows:

1. Energy Conservation - Solid Waste
   - reclamation of paper, plastics and other waste products which have significant heat value is not compatible with utilizing solid waste as fuel for thermal electrical generating plants or the pyrolysis process.
2. Energy Conservation - Sanitary Wastes - Solid Wastes
   - the use of garbage grinders for the putrescible portion of solid wastes would assist solid waste generators, particularly housewives, to separate paper, metal and glass at the source. This method is at present the most economically feasible means of material reclamation.
   - such practice would, however, increase the solids and organic load on the sewage treatment plant resulting in additional waste sludge disposal problems.
   - such practice would also decrease the heat value of solid waste should it be desired for use as a fuel.
3. Energy Systems - Electricity, Gas, Oil & Solid Waste
   - if recommendations are to be made on which energy systems should be installed at North Pickering and for what uses, a study of much wider scope than this co-ordination area or the North Pickering Project itself, must be carried out. Such a study would have to be, to some extent, international in scope involving resource inventory, allocation and pricing policies, etc.
4. System Location - Transportation - Environment
   - the most suitable location for services and utilities may not be in locations which are most suitable from an environmental or transportation viewpoint, e.g. sewers following valleys, or parkway belts, or transportation routes.
5. Solid Waste - Gas Transmission - Transportation
   - multi-use could possibly be made of various pipeline systems for solid waste collection, goods distribution or energy transmission. Certain materials could be carried simultaneously in various sections of a system or alternately a system initially designed for say natural gas distribution could possibly be adapted to future use for water supply or oil distribution.

6. Storm Run-off - Environment - Open Space Planning
   - environmental and services co-ordination areas must interact in determining the locations and methods used to regulate storm water run-off quanity and quality.
7. Communications - Social Planning - Public Participation
   - the degree and nature of services that will be provided in the communications field will be established in co-operation with social planners and public participation groups.

Continuing phases of the overall study will follow up on the broader areas of implication, and alternative community planning concepts will be evaluated concerning the applicability of various innovative servicing concepts.

2.3 Standards and Criteria

2.3.1 Residential Servicing - Municipal

The 'State of the Art' Studies were carried out on a broad level and did not investigate in detail the specifics of design and construction criteria and standards. At this more detailed level of consideration, recommended standards for traditional municipal services have been studied and reported on in the recently completed 'Recommended Guidelines for Residential Servicing in Ontario' by the Ontario Housing Advisory Committee.

The Study was undertaken to establish province-wide minimum acceptable servicing standards and practices. Included in the study are all services and utilities normally contained within the residential road right-of-way as well as standards for the road, curb and sidewalk and consideration of the width of road allowance required.

By adopting the standards proposed, possible savings of from 5% to 40% may be realized on the construction cost of the specific services provided. Further savings may be achieved, in land use, by reducing the right-of-way from the normal minimum width of 66 feet to 56 feet for minor local roads or 60 feet for local roads.

These standards are recommended as broadly applicable and do not preclude the establishment of individual local standards as considered advisable for the North Pickering Project. However, traditional municipal services provided for North Pickering will probably conform to the majority of the guidelines recommended.

Several aspects of the broad servicing question were identified as worthy of further research:-

1. Utility companies are active in co-ordinating locations within the road allowance and greater effort should be concentrated on the overall co-ordination of the location of all services within the road allowance. This ties in with the 'multi-utility' study currently underway for North Pickering.

2. Further research into the relationship between storm sewer sizing and costs and selection of design storm and flood protection criteria is required.

3. The Canadian Underwriters Association requirement for fire fighting protection should be re-evaluated in light of current construction standards and fire fighting practices.

4. Legislation which regulates drainage changes by private land owners should be reviewed with a view towards simplifying and strengthening control of changes.

2.3.2 Residential Servicing - Electrical

A separate report on electrical servicing was also recently prepared for the Ontario Housing Advisory Committee, to review and evaluate current practices of providing electrical service to residential areas.

The report discusses the relative merits and compares the costs for underground vs. overhead construction and rear lot vs. road allowance location.

Ontario standard practice is reviewed and it is noted that there are considerable variations in materials, design parameters, and installation practices from area to area.

The inconsistency of standards, the large number of small utilities and their inflexibility to change, problems of rear yard underground location, and preservicing or oversizing for possible future development are all identified as contributing to higher costs of electric servicing. Improvements and modification directed at these areas can lead to improved service at lower cost.

Many of the traditional problems experienced in the past in other areas of the province will not be encountered in North Pickering which will be dealt with in a co-ordinated overall way.

3. INITIAL ASSUMPTIONS AND ISSUES - DISCUSSION PAPER NO. 1

Discussion Paper No. 1, prepared soon after commencement of the study, outlined some of the initial findings regarding existing and proposed regional service networks and considered opportunities and options available to utilities planning for the new community.

The North Pickering site is relatively free of existing service and utility networks which could act as development constraints, yet is capable of being readily serviced from adjacent existing or proposed facilities. Thus an excellent opportunity exists to establish modern and flexible infrastructure networks planned to accommodate current and future needs at reasonable cost.

3.1 Status of Regional Services

Several major physical factors affecting community design, apart from natural site features, which are discussed under the Environment, are shown on the accompanying drawing entitled 'Regional Services'.

3.1.1 Sewers and Water

The Ministry of the Environment has recently completed an updated report on regional sewage and water systems to be provided to serve portions of Central York and Pickering. Further study is underway on the proposed location of the major transmission sewer across the project site and current thinking is that it will closely follow the Openspace System.

3.1.2 Sanitary Landfill Sites

It is probable that the proposed Liverpool Road landfill site will be developed in the relatively near future by the Municipality of Metropolitan Toronto. Since most of the innovative methods of dealing with solid waste require landfill sites for ultimate disposal of some final wastes, it would be advantageous for the new community to participate in landfill operations in or close to the site, whether carried out under the jurisdiction of Metro, the Durham Region, or the Province.

3.1.3 Telephone System

Bell Canada, as a result of studying the requirements of the proposed development, proposes to locate an electronic switching centre in the Whitevale area to link the proposed community and airport to the existing Bell network.

3.1.4 Existing and Proposed Hydro Lines

Major power lines existing in the southerly portion of the study area tend to form a natural limit to the area of new development.

The location of the proposed 500 KV Nanticoke to Pickering major transmission line is still under review by the Solandt Commission, but it is probable that the location selected will closely approximate existing routes across the site and will be within the Openspace System.

The North Pickering Project will be served by a transformer station located to the south of the community likely in the vicinity of Cherrywood adjacent to the existing transmission lines. Depending upon distribution voltage and load demand in the Region, another station located to the north or east of the community may be required. A new 230 KV line would be required to this northerly or easterly transformer station.

3.1.5 Existing Oil and Gas Pipe Lines

The existing Trans Northern Oil Pipe Line traverses the project site and poses a planning constraint related to the inability to build structures over the existing 60 foot right-of-way. It is anticipated that some degree of selective re-location and reconstruction could possibly be arranged if necessary to suit ultimate plans for the project.

It has recently been proposed that the Interprovincial Pipelines Company construct a new 30 inch diameter oil pipeline across North Pickering. This line would form part of the Federal Government's proposed Sarnia to Montreal oil pipeline system. The initial alignment suggested would generally follow the existing Trans Northern Pipeline route. However the route is actively being studied and the implications of the pipeline will be reported on at a later date when more information is available.

The existing Trans Canada natural gas pipe line traverses the proposed airport site somewhat north of the North Pickering Project. This location is relatively convenient for the provision of any new connections required for service to the community or the airport.

3.2 Toronto Area Airport Project

Not too much is known as yet concerning the specific location and details of proposed new airport facilities. The airport site could pose certain constraints on the North Pickering Project concerning type of development immediately adjacent to the boundary, but offers the opportunity of linked or shared services and communications networks.

4. GOALS AND OBJECTIVES

Work carried out preparatory to the issuance of Discussion Paper No. 2 included translating the initial Project Goals and Objectives published in 1972, into more specific targets related to the planning of services, utilities and communications networks.

Tentative objectives were developed related to many of the overall Project objectives and those specific to the services area are summarized as follows:

> "To ensure that the Community utility services such as water supply, sewage collection, transportation and other infrastructure, are integrated into the planned regional facilities."

1) Water and sewage systems will be integrated with the proposed Central York-Pickering Servicing Scheme.
2) Solid waste disposal will be co-ordinated with proposed Metro Toronto or Durham Region sanitary landfill sites within and adjacent to the Community.

> "To provide the Community with a comprehensive, innovative and economical system of utility services which are a model of technical, environmental and aesthetic excellence, and to allow the greatest possible flexibility for change as development proceeds."

1) Technological innovation will be applied, where warranted, to the design process, materials selection, the construction process and the maintenance and operation of systems proposed. The degree of innovation will, of course, be subject to economic considerations.

2) Co-ordinated planning will result in systems with the required flexibility for future variations in Community needs related both to the nature and extent of servicing systems and the level of service provided.

3) Systems operation and administration will be evaluated towards improved efficiency and reduced duplication of effort resulting from overlapping jurisdictions.

> "To ensure that the Community is served by an efficient, economical range of telecommunication systems."

1) Canadian telecommunications systems are, at present, efficient and economical. The new community will have a communications system which starts from this base and will include or allow for new equipment

and hardware as well as expanded services for both the private and commercial sectors.

"To ensure that the development and operation of the Community adheres to the principle of the conservation of energy."

1) Opportunities to conserve energy will be taken, where feasible, through design of servicing systems that are efficient in energy comsumption.

2) Recovery of energy from waste heat or waste solid materials will be practiced when and where feasible.

4.1 Detailed Objectives

These tentative objectives give rise to the following areas of study related to achieving overall aims, which include the provision of systems to at least current standards and levels of service, and investigating innovative methods of improving service, reducing costs and eliminating duplication of effort.

A. Water Supply and Distribution

1. To provide a reliable supply of water in both quality and quantity for residential, commercial and industrial consumption and other community uses.
2. To provide a reliable system of water distribution for fire protection through hydrants and automatic sprinkler systems.
3. To investigate the technical and economic feasibility of providing separate water systems of differing quality depending on end use.

B. Sanitary Sewage Collection and Treatment

1. To provide a complete system of sewers to collect liquid waste from the residential, commercial and industrial areas of the community.
2. To enact industrial waste bylaws to limit the composition and strength of liquid wastes that may be discharged to the sewers.
3. To provide a suitable method for the disposal of high strength, toxic, corrosive, inflammable and pathogenic wastes excluded from the sewers.
4. To evaluate and select a system or systems for the conveyance of sewage (gravity sewers, vacuum sewers, pressure sewers). In addition, to evaluate the use of water for the conveyance of human waste and study the possibility of reducing or eliminating the major demand for water arising from use of flush toilets.

5. To evaluate and recommend on the location of sewers with respect to roads, walkways, parks and also with respect to other services and utilities (i.e. common trench, utility corridors, utilidors).

6. To evaluate and recommend the materials and methods of construction for sanitary sewers, as for other services and utilities.

7. To ensure that the conveyance systems, volume and characteristics of the waste to be produced are co-ordinated with the proposed treatment processes.

C. Storm and Ground Water Drainage

1. To evaluate the use and location of storm sewers.

2. To co-ordinate the storm drainage requirements with other area objectives such as Environmental and Transportation.

D. Solid Waste Collection and Disposal

1. To evaluate and select methods for the efficient, safe, sanitary collection of solid waste. The choices include roadside or back-of-house truck pickup, in-home grinding or compacting, segregation into material types, pneumatic and mechanical transport.

2. To evaluate methods of ultimate disposal of solid waste including landfilling, recycling, incineration, composting, and treatment of organics with sanitary sewage.

E. Electrical Power Distribution

1. To co-ordinate the installation of electrical plant with other services and utilities.

2. To provide an electrical system capable of meeting the needs of the community including residential, commercial and industrial and also municipal requirements for street lighting, transit vehicles and public works.

3. To establish an efficient method of administration for meter reading and billing for electrical systems as for other service charges.

F. Other Services

1. To co-ordinate the location and extent of other energy supplies such as oil and gas distribution networks.

G. Communications

1. To provide a modern, efficient telecommunications system that will take advantage of the latest technology

to increase the range of services to be provided either initially or in later stages.

2. To co-ordinate communications systems with each other and also with other services and utilities.

H. Public Health and Safety

1. To provide a system of utility services that comply with or exceed the public health and safety requirements of the various provincial Ministries, such as the Ministry of Labour, Ministry of the Environment, Ministry of Health, Ministry of Transportation and Communications and others.

2. To create the necessary standards of health and safety that will be required by innovative systems.

4.2 Incompatible Goals and Objectives

As the objectives for the community are enunciated more specifically for the various areas of concern, it becomes apparent that conflicts will exist. Priorities and methods of weighing and rating of objectives must be developed and compromise will be required to arrive at a realistic and attainable set of objectives. Areas of potential conflict in objectives stated for service, utilities and communications include the following:

1. To be innovative yet economical may be conflicting aims. Often innovation resulting in new or better services may add to the cost associated with the provision of these services. Some types of innovation, however, will result in conventional systems being provided in a more economical way.

2. Preservation of the enviornment, while desirable, is not totally possible. Creation of a sizeable community will result in changes to the environment. The alternative to following natural drainage patterns and locating trunk sewers in the valleys, could be a dramatically expensive system of pumping stations and forcemains. Careful evaluation of economics versus environmental impact will be required.

3. Consideration of aesthetics as applied to utility services will occasionally be tempered in light of cost of functional implications.

4. Great flexibility can be provided in the planning stage but as implementation takes place by stages, the degree of flexibility decreases. For instance, trunk and sub-trunk water supply and waste disposal systems must be designed for a specific maximum demand. To avoid wasteful oversizing or costly duplication in future, the degree of flexibility will, of necessity, be progressively limited as implementation proceeds.

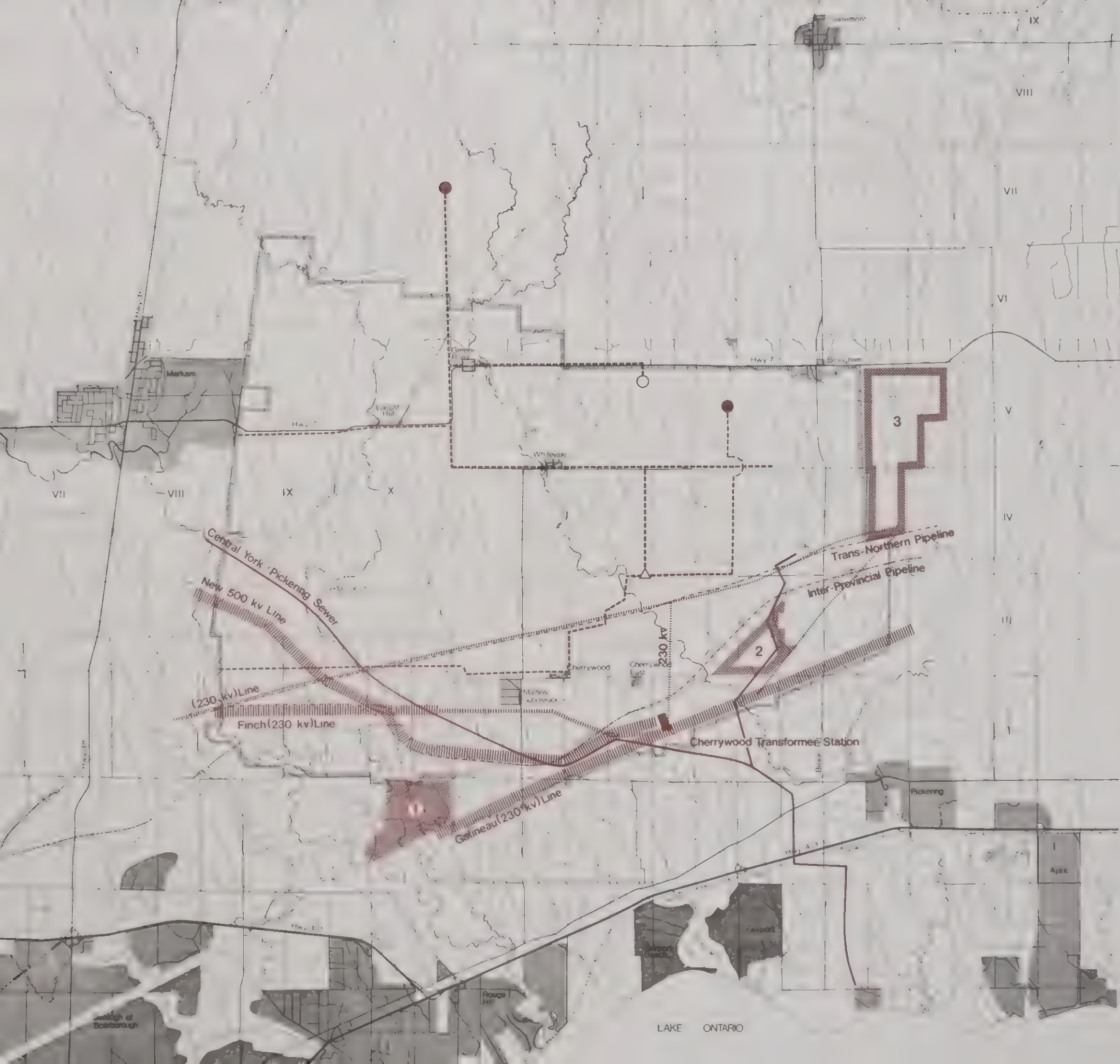
5. COMMUNITY SERVICES AND UTILITIES

During Phase I, studies were conducted to summarize the 'State of the Art' of various aspects of overall services, utilities and communications networks. These studies generally cover current practices and innovative concepts, and examine the technical and economic feasibility as applicable to the project.

The studies cover traditional services including water and sewerage, energy and communications systems, and also look at broader and inter-related questions such as water conservation, management of storm water runoff, innovative methods of handling solid wastes, energy conservation, and the applicability of a 'multi-utility' approach to systems location and administration.

Applicable findings of these studies are contained in the Appendix of this report.

North Pickering Project



HYDRO LINE
OIL PIPELINE
TRUNK SEWER
} Existing or Committed

PRESSURE REDUCING VALVE
ELEVATED TANK
WATER RESERVOIR
WATER PUMPING STATION
WATER MAIN
WATER POLLUTION CONTROL PLANT
SANITARY LAND FILL SITE:
1. EXISTING BEARE ROAD SITE
2. COMMITTED LIVERPOOL ROAD SITE
3. PROPOSED BROCK ROAD

EXISTING & POTENTIAL SERVICES & UTILITIES

100 HECTARES
100 ACRES
1 KM
1 MI

Date
Scale
Number

plantown consultants limited

North Pickering Project Team
Ministry of Housing
Province of Ontario

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STATE of the ART REPORTS

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1.0 WATER SUPPLY & DISTRIBUTION

1.1 INTRODUCTION

Ontario has an abundance of water of sufficient quality that, with only a few exceptions, water supply has not been a major concern for the general public. Nonetheless, because of its universal importance as a base resource, discussions as to its quality, quantity, uses and means of transmission must be raised. This report outlines basic considerations of water supply systems, existing methods of storage and transmission, innovative techniques and methods, and applicability to North Pickering. The scope is limited to municipal water supplies and distribution works and excludes detailed discussion of alternate water treatment processes.

1.2 CURRENT PRACTICE

1.2.1 General

There are basically three sources of water supply available; rain water; surface water; and ground water. The source chosen affects the method of collection, purification, transmission and storage.

Rain water has not been used extensively in Canada, particularly in Ontario, as a direct source of municipal supply for domestic use. It is used in some instances on an individual basis as an alternative to hard water for washing and laundry purposes. The unpredictability of the source precludes most uses other than such activities as may occur in the natural envirnment.

Surface water, supplies approximately 86% of water used in Ontario. While quality differs with source, adequate treatment methods exist allowing a high drinking water sources. In areas where fresh water is not readily available, brackish or saline water can be physically and chemically treated to reduce pollutants and enhance the quality to meet drinking water criteria.

Ground water can be found in limited quantities throughout most areas of Ontario and in some cases, such as the Kitchener-Waterloo area, it is available in sufficient quantities to supply large scale development.

Ground water generally requires less treatment than surface water and thus, if readily available, is a more economic municipal supply.

Even with the acknowledged abundance of water in Ontario, some areas, notably the southwestern parts, have experienced water shortage problems. These are invariably municipalities which are dependent on ground water sources for their supplies. In most cases, alternative cources of supply, either new ground water sources, or pipelines to surface sources, have been successfully initiated.

1.2.2 USES

Uses of water may be broadly categorized under the following headings:

a) agricultural
b) aquatic life, wildlife
c) industrial
d) public (domestic, commercial and institutional)
e) aesthetic, recreation
f) hydro power and navigation
g) transport, dispersion, and assimilation of wastes.

These uses have varying requirements as to quality and quantity and as well have sub-uses in each category.

While the importance of the categories is recognized, the following discussion is limited to public water supplies with a few references to other uses, in particular, industrial and agricultural.

The Ontario Ministry of the Environment has estimated that some 30% of Ontario's population, mostly in rural areas, is dependent on individual ground and surface water supplies. In areas where municipal distribution systems are established, approximately 60% of the water supplied is drawn from the Great Lakes, 20% from ground water sources, and 20% from inland surface sources.

1.2.3. QUANTITY

Where individual sources are utilized as the main water supply, 50 gallons per day, discounting agricultrual uses, is estimated to be used by each person. In a predominatly residential community, served by a communal water system with little industrial water requirements,the per capita consumption varies from 50 to 80 gallons per day and increases to 100 gallons per day when secondary uses such as lawn watering or car washing and moderate industrial uses are included. In industrialized areas, where municipal supplies are required to meet at least part of the industrial demand, 200 gallons per capita per day are not uncommon, as an average demand rate. In general, for communities with a significant industrial base, the industrial water demand should be evaluated for the specific industry rather than attempting to estimate the demand based on an equivalent population and its per capita demand.

Community fire-fighting water quantity requirements are generally established in accordance with the Canadian Underwriters' Association standards. Fire insurance rates for buildings in the community are related to how well a community meets these standard requirements.

Generally the source of supply should be capable of meeting at least the peak day demand of a community. Shorter term demands are normally met by storage within the system. Peak day demands for predominatly residential communities range from 1-1/2 to 3 times the average day demand depending upon the size and nature of the community.

1.2.4. QUALITY

The quality of water, regardless of the source, is generally good in Ontario. Water quality standards based on drinking water needs, however, do not reflect the multiple uses and the needs of all the uses referred to earlier. Although domestic water supply is accorded top priority and high quality standards are set to accommodate this, other needs may in fact require more stringent standards. For instance, distilleries can only utilize demineralized water, certain agricultural products irrigated by softened water may be harmed, and aquatic life may be endangered from concentrations of copper and zinc permissible in domestic water supplies. In general, industrial water users recognize that non-variable water quality is just as important as good quality water. In many cases, heavy industrial users supplement municipal supplies with their own supply.

1.2.5 TRANSMISSION AND DISTRIBUTION

Water from the source of supply following treatment is delivered to users through a piped distribution system. In a few instances where topography permits, gravity sections can be utilized generally in the form of aqueducts or channels. Water is forced through transmission mains to storage reservoirs. The storage reservoirs are usually located such that they are at sufficient elevation to supply as large an area and as many users as feasible by gravity from the head of water in the reservoir. This area which can be serviced at the same head of water is called a pressure zone. The reservoirs serve to meet peak demand rates in excess of the rate at which the source, treatment plant or transmission facilities can supply water. They also provide a reserve supply to meet fire-fighting requirements and other demands due to possible failure of the supply system Generally a single pressure zone can service an area which has a variation in topography of up to 150 feet. If the topography of the serviced area varies by more than 150 feet it is usually necessary to divide the area into more than one pressure zone each with its own storage reservoir and distribution system.

From the reservoir, trunk water mains carry water to local distribution mains which distribute water generally in accordance with the street pattern to the properties of the consumers. Consumers are connected to the local mains to obtain their water supply. The pressure in the local mains is generally sufficient for consumer needs. However, high rise development, and other areas of high relative elevation within a community, often require booster pumping to meet consumer requirements. Hydrants for fire-fighting purposes are located along the transmission and distribution systems in built-up areas.

Pipe materials used in the pressurized transmission and distribution systems include cast iron, ductile iron, asbestos cement, steel prestressed concrete, reinforced concrete, polyvinyl chloride, and polyethylene. Pipes are laid at sufficient depth, usually at least 6 feet, to prevent freezing of the lines during winter.

1.2.6 ADMINISTRATION AND CONTROL

The Ontario Ministry of the Environment has been vested with the necessary powers to control and regulate the collection, production, treatment, storage, transmission and distribution of water and to generally make available supplies of water for public use. It has the authority to construct, operate and maintain water works throughout the province, with the provision that local or regional authorities, such as public utilities commission's (P.U.C.) are given jurisdiction as laid out in the Municipal Act.

Local and regional authorities can implement, develop, construct and maintain water works in their own jurisdiction subject to the Ministry's approval of proposed works. Constraints may be established by the Ministry of Health and The Ministry of Natural Resources through the Conservation Authorities whose jurisdictions may overlap with those of the Ministry of the Environment and the local authorities. Simply, the local and regional authorities administer, regulate and control water supply systems within guidelines established by the Ministry of the Environment.

1.3 INNOVATIONS

1.3.1 General

Innovations in this field, as applicable to Ontario conditions, have evolved with advancing technology but without major changes in perception and direction. Generally, the planning has involved supplying water at the lowest cost, and with no restrictions as to usuage, with the exception of large demands by industries. In this respect, traditional methods and procedures have been followed with minor changes arising from computerization, consolidation of utilities, new materials and techniques, and improved quality standards.

1.3.2 USES, QUANTITY AND QUALITY

Although not strictly in an innovative sense, a classification relating quality to uses, especially domestic uses, can be valuable not only in the design of supply systems but in conservation of existing sources as well. Water quality criteria are based on drinking water standards concerning health and safety and not on industrial needs, or secondary uses such as, recreation, lawn-watering, or fire-fighting which can be the largest demand. Relating quality to use may result in conflicts of priority and the perception of what a municipal water supply system should transport. Nonetheless, multiple uses are possible with secondary uses generally requiring lower quality water. As mentioned in the Sanitary Wastes, and Water Conservation and Re-Use reports, use of recycled water for secondary uses is technically feasible and can be economically feasible in certain instances.

1.3.3 TRANSMISSION AND DISTRIBUTION

The transmission and distribution of water from the source of supply to the end use has not undergone any significant innovative changes in the recent past and few are foreseen for the immediate future. Innovations that have occurred are in the fields of design, administration, construction procedures and materials.

Computer design of services, standard and common trench location of the distribution lines and automatic meter reading techniques are among the more notable developments.

Utilidors have been cited as an innovative method of consolidating municipal services in a common and accessible location. While this has advantages of reduced maintenance costs, traffic interference and street deterioration, the substantially higher costs of installation, incompatibility of services within the tunnel and planning and co-ordinating difficulties usually render the concept infeasible, except for highly concentrated central business core type development.

Polyelectrolytes have been used to decrease friction losses in distribution systems during peak demand periods, such as fire-fighting, but are not practical for continuous use because of high costs. The use of ozone as an alternate to chlorine for disinfection has been generally accepted by authorities and is becoming more popular. The use of foam lines for fire-fighting may be feasible in some instances, such as for areas where fire demand greatly exceed normal domestic demands, or for areas where maximum use is made of recycled waste water.

1.3.4 ADMINISTRATION AND CONTROL

As outlined in the report on Water Conservation and Re-Use, legislation in pricing policies can be an effective method of controlling water use.

Recent innovations in metering, operation and control of water distribution systems involving automatic meter reading, monitoring distribution system demands with feedback control utilizing telemetering, radio transmission and computer facilities will greatly change traditional administration and control practices.

1.4 APPLICATION TO NORTH PICKERING

1.4.1 SUPPLY

Since Lake Ontario is within a few miles of the proposed Pickering Community and since a regional water supply system utilizing Lake Ontario water will provide high quality water at the necessary pressures to the Community, it is not really feasible to consider alternate water supply sources for other than small, isolated, low density areas or possibly for some low quality uses.

Industry should be encouraged to reduce their raw process water requirements and subsequent waste discharges by treating and recycling as much process water as possible. In isolated areas to service low density development, such as agriculture, parkland or estate-type residential development, it may be feasible to utilize local ground or surface water sources to a limited degree.

Water of lower quality than that required for drinking water can often be used for non-consumptive uses such as fire-fighting, irrigation, toilet flushing, industrial uses and many washing applications. Due to the readily available and economical supply of drinking quality water, it is not considered to be economically feasible at this time to provide a second complete water distribution system for low quality water. Advantage should, however, be taken of untreated local surface water sources for uses such as irrigation of parks and gardens.

1.4.2 DISTRIBUTION

For North Pickering it is not expected that the traditional means of distributing water will vary significantly. The transmission lines and storage reservoirs will likely be provided by the Ministry of the Environment Regional Supply System. Sites and easements for these lines will be required in North Pickering. It is recommended that the domestic water demand, fire demand, water main valve and hydrant design practices and standards, materials and locations all be generally in accordance with the report recently published by the Ontario Housing Advisory Committee entitled Recommended Guidelines for Residential Servicing in Ontario.

In areas where the fire demand is much greater than normal peak demands, consideration could be given to utilizing chemical type fire-fighting systems rather than oversizing the water mains. Alternately, the feasibility of adding polyelectrolytes to increase water main capacity during infrequent, very high demand periods is worth further evaluation.

1.4.3 ADMINISTRATION AND CONTROL

Recent innovations in metering, operation and control of water distribution systems involving automatic meter reading, monitoring distribution system demands with feedback control utilizing telemetering, radio transmission and computer facilities are technically feasible and appear applicable to North Pickering. Further studies should be carried out to evaluate the economic advantages of such systems for both the individual utility and combined systems serving multi-utilities. This facet is covered in more detail in the Systems Administration report.

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SANITARY WASTE

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2.0 SANITARY WASTE

2.1 INTRODUCTION

This report summarizes current practice, innovative techniques and application to North Pickering in the sanitary waste eld generally under the headings of generation, collection, treatment, disposal, administration and facilities location. Treatment and disposal are covered only briefly since it is expected that the major portion of the sanitary waste generated by the proposed development will be handled off-site in facilities provided by the Ministry of the Environment, Regional Sewage Works Scheme. Separate reports entitled Systems Administration and Systems Location should be referred to for additional information on these particular aspects.

2.2 CURRENT PRACTICE

2.2.1 Generation

Sanitary wastes can be defined as liquids and water-carried wastes generated from residences, commercial buildings, industrial plants and institutions, together with minor quanitities of storm and ground waters that are unintentionally admitted to the sewerage system through infiltration and inflow.

Sanitary waste quantities can generally be directly related to water consumption. Water used for domestic purposes such as laundering, bathing, food preparation and bathroom facilities usually generate a sewage volume equal to about 80% to 90% of the water consumption. However, water used for lawn and garden watering, private car washing, fire-fighting and other outside uses will not normally gain access to the local sanitary sewer except through infiltration through the ground.

Quantities of sewage per capita vary considerably in different countries and are related to availability of water, social habits and related factors. For predominantly residential areas, with little industrial or commercial development, per capita sanitary sewage flows range from approximately 50 to 80 gallons per day.

For commercial areas the flow can vary greatly, depending upon type and density of development, from approximately 3,000 to 150,000 gallons per day per acre. Other than for central business districts of large cities, the average for Ontario is in the order of 4,000 to 5,000 gallons per acre of commercial development.

Industrial waste is made up of process waste and domestic sanitary waste from employees. The quantity of process waste varies from a few thousand gallons up to hundreds of thousands of gallons per acre per day, depending upon the type and size of the industry, the processes utilized, the degree of recycle and the costs assessed for discharge versus the costs of in-plant treatment. The domestic sanitary waste from industry is directly related to the number of employees, number of shifts and the facilities provided such as cafeteria, showers and clean-up facilities. Generally in Ontario the average domestic sanitary waste from industry is in the order of 2,000 to 5,000 gallons per acre per day.

For the design of sanitary sewers and treatment facilities the generally accepted average design flow from urban areas including residential, commercial and light industry is 100 gallons per capita per day. This value includes allowance for infiltration,local commercial and some increased future water use. In the absence of specific information a population equivalent of 30 to 60 persons per acre per day is generally allowed for commercial and light industrial areas. For any relatively large scale commercial or industrial areas the actual sewage flows expected from the various establishments are used for design.

Peak flow factors are generally assumed to vary with the population in accordance with either the Babbit or Harmon formulas.

Summary of waste quantities generated:

Residential - 50 to 80 gallons per capita per day.
Commercial - 3,000 to 150,000 gallons per acre per day. (Ontario average 3,000 to 5,000 gallons per acre per day)
Industrial - 3,000 to several 100,000's gallons per acre per day. (Ontario average 3,000 to 6,000 gallons per acre per day for light industry)

2.2.2. Collection

A sanitary waste collection system conveys sewage from the point of generation to the treatment or disposal location, in an aerobic state where possible, while protecting health and property against contamination in an aesthetically acceptable manner.

The traditional and most commonly used system for conveying sanitary waste is by gravity flow in pipes, with the use of pressure sections only where necessary to alleviate difficult construction conditions and reduce excessive costs of a gravity system.

a) Gravity System - From building connections, sewage flows by gravity through local, collector and trunk sanitary (or combined storm and sanitary) sewers, generally of increasing diameter, to a collection point which may be a water pollution control plant, a pumping station or a natural outlet if no treatment is provided. Combined systems often incorporate sanitary relief sewers which discharge surcharged flow directly to watercourses along the route during periods of high flow caused by storm runoff. In Ontario, concentrated efforts have been and continue to be made in most municipalities to replace combined sewers with separate sanitary and storm sewer systems. In some areas of Canada as well as other parts of the world, combined sewers are still being constructed sometimes for economy, but in other cases in order to permit the treatment of storm water as well as sanitary sewage prior to discharge to receiving waters.

b) Pressure System - Where the collection system must overcome obstacles not economically or technically feasible by gravity flow (i.e. flow to a higher or a distant point) a pumped pressure system is used. This requires the use of a wet or dry well type pumping station and a force main to the next gravity sewer, pollution control plant or natural outlet if no treatment is provided.

The choice of pipe material for the sewage collection system is dependent upon chemical composition of the sewage, physical and chemical properties of soil and ground water, size, depth, external loading, available bedding and backfilling materials and local regulations. In general, vitrified clay pipe is used for industrial sewers where corrosive sewage is thought to be present. Concrete or asbestos cement is used for non-corrosive industrial areas and almost exclusively for other areas. Concrete and asbestos cement pipe manufactured using sulfide resisting cement can be used for certain corrosive conditions. Thermoplastic pipes have recently been used for some sewer applications. Where stronger pipe is required, or for force mains, extremely shallow or deep sewers, other materials in use include cast iron, ductile iron, steel, polyvinyl chloride or steel reinforced concrete pipe.

2.2.3 <u>Treatment</u>

Current methods of sewage treatment include dilution, septic tanks, waste stabilization ponds and various types of mechanical, chemical and biological treatment plants.

a) Dilution - Raw or partially treated sewage is discharged to a large water mass where dispersion and dilution can provide satisfactory reduction of the pollution load.

b) Septic Tanks - Common in Canada for pre-treatment of liquid wastes from an individual home, or relatively small commercial establishments in rural or relatively low density development areas, prior to subsurface disposal of the effluent generally by tile beds. Applicable to areas where municipal collection and disposal systems are not economically feasible due to low density development and where soil conditions are suitable.

c) Waste Stabilization Ponds - Commonly used throughout Canada to service smaller communities and large communities on occasion, where land values are low, isolation distance can be economically achieved, and where minimum operation and maintenance is a prime concern. This treatment method is well-suited to ultimate disposal of effluent by spray irrigation since a large amount of storage is provided in the treatment process.

d) Treatment plants - Most common method of treating municipally collected liquid waste and also the method most commonly used by industry to pre-treat waste prior to discharge to municipal sewage systems to meet sewer-use bylaws. Plants are presently used to treat wastes for a wide range of flows from a few homes to the largest cities. Plants are generally a combination of physical, chemical and biological treatment processes which can be designed to obtain the desired degree of treatment, varying from simple physical screening of solids to achieving potable water quality effluent.

2.2.4 Disposal

Except for the direct dilution method of treatment the other methods all require the disposal of treated liquid effluent, thickened and partially stabilized sludge, and certain gaseous by-products of the treatment process.

a) Effluent - In septic tank systems the liquid effluent is usually disposed of by tile field percolation-evaporation type systems, leaching pits or other soil absorption methods. In waste stabilization ponds and mechanical treatment plant systems the liquid effluent is usually discharged into suitable watercourses or is occasionaly disposed of by spray irrigation on vegetation.

b) Sludge - Sludge from septic tanks is usually disposed of on agricultural land where it has some limited value as a fertilizer or soil conditioner. Alternately, if land

disposal is not feasible due to weather or other conditions, septic tank sludge may be disposed of at sewage treatment plants. Although not recommended by most authorities, septic tank sludge is sometimes disposed of in sanitary landfills or garbage dumps. Sludge from sewage treatment plants after undergoing various degrees of processing both to purify it and to reduce the water content is usually disposed of on land or by incineration.

c) Gas - The gas emitted from anaerobic sludge digesters, which generally contains a high percentage of methane, is sometimes used as an energy source to fire plant boilers. If the energy is not required the gas is usually burned as waste and discharged to the atmosphere.

2.2.5 Administration

Private waste disposal systems which do not discharge effluent to receiving streams, such as septic tank-tile beds, have in the past been administered by the local Medical Officer of Health through the District Health Unit. Recently, the Ministry of the Environment has taken over this responsibility from the Medical Officer of Health in many regions of Ontario and will probably be responsible for all areas in the near future. All sewage works constructed on private property are generally maintained by the owner in accordance with the appropriate plumbing codes and/or Health Unit requirements.

Local municipalities generally are responsible for sanitary waste after it enters the collection system at the streetline. The collection systems are normally the responsibility of the municipality with trunk sewers, pumping stations, force mains, and disposal facilities owned and maintained by either the municipal, regional or provincial government body. The Ministry of the Environment is, however, responsible for the approval of such works, even in cases where the Ministry is not directly responsible for operation and maintenance. Representatives of the Ministry periodically inspect systems to ensure that they are functioning satisfactorily.

Methods of charging for sewage facilities vary considerably in Ontario. In communities where the Ministry of the Environment installs sewage systems, the user is usually charged a levy based upon the unsubsidized portion of the total capital cost. The levy can be paid as lump sum or in installments over many years. The remainder or subsidized portion of the capital cost of the works is paid for out of general provincial tax revenue. In new developments the developer usually is responsible for installing the local sewers and pays a lot levy to cover the cost of external services and treatment. Both

of these charges are then transferred to the lot or building buyer. Where existing sewage facilities need upgrading the capital cost of the work is shared by those who benefit from the work, through local improvement type charges and sometimes partly through general taxation. The cost of maintenance and operation of sewage works is normally taken from local taxes or added as a surcharge to the water bill.

2.2.6 Location

Where a gravity type collection system is used, the topography of the serviced area greatly influences the location of the pipes and treatment facilities. Municipal sanitary sewage collection mains are usually located within the road allowance. Ravines and other natural depressions have been preferred locations for trunk and sub-trunk sewers, with pumping stations or treatment facilities generally located close to receiving waters at the outlet end of the drainage basin.

2.3 INNOVATIONS

2.3.1 Generation

Improvements in water supply and waste disposal systems tend to encourage the public to use more water and thus generate more sewage. The quality of sanitary sewage is also changing with increased standards of living and changing living habits. For example, with increasing affluence, the use of garbage grinders in residential units will likely become more popular where they are not prohibited. The use of such in-house units reduces the quantity of putrescible solid waste to be disposed of from the home, but results in an increase in the suspended solids and organic content of sanitary sewage. Collection and treatment facilities have to be designed to handle such increased loads.

In the industrial field standards for effluent discharge are becoming stricter, which often results in the industry discharging wastes to the municipal sewer system, sometimes after pre-treatment, rather than directly to a receiving stream.

Pilot plant scale recycling plants for domestic waste are presently being seriously evaluated. If such systems prove to be technically and economically feasible, the wastes from an apartment complex or a small concentrated community could be recycled with only a small percentage of make-up water required for normal domestic uses. It is unlikely that such systems will gain broad public acceptance except in areas of extreme water shortage and for secondary useage of water such as washing, toilet flushing and industrial process

water requirements. The long-term health implications of human consumption of recycled domestic waste have not yet been adequately evaluated, according to many researchers. However, if such systems were to be used even for secondary uses, the size of municipal water and sewage systems could be significantly reduced.

2.3.2 Collection

a) Low Pressure Sewer Systems - Low pressure sewer systems have been introduced as a solution to the problem of rising costs of conventional gravity systems. The sewage from each home is passed through a grinder pump and discharged at low pressure through a series of pipes, some of which may be gravity sewers, to the treatment facility. The system uses small diameter plastic mains which can be laid at any grade. Such systems are suitable in areas where deep trench construction is difficult due to rock or poor soil conditions, in very rugged terrain or in existing low density built-up areas where septic tank systems are being replaced by a municipal collection system. Low pressure sewer systems are in use in a few isolated developments in the United States but have not yet been used in Ontario to our knowledge.

b) Vacuum Sewage Systems - The vacuum system of domestic waste collection was developed in Sweden and is also in use in England, the Bahamas, Israel, Mexico City, and recently in parts of the United States. The system operates on the principle that domestic sewage is split into "black water" (from water closets) and "grey water" (from sinks, bathtubs, showers, etc.). The black water is sucked from the house fixtures to the trunk system while the grey water is discharged to storm drains or seepage pits. The system reduces the volume of water required for flushing and thus reduces the conduit sizes. The plastic conduits can be laid on horizontal or even reverse grades at shallow depths. Grey water can also be handled by the system but the economic feasibility of the system is adversely affected in such instances.

The advent of low pressure and vacuum systems means that sewers can be laid at a constant depth of approximately 5 to 7 feet, generally in accordance with the topography, thus eliminating the need for deep sewers common with conventional gravity sewer systems. The possible increased energy requirements of these more innovative systems as compared to the more traditional gravity system must be evaluated.

Construction of shallow sewer systems using trenching machines as opposed to conventional backhoe equipment could result in capital cost savings under certain conditions. At this time it is not expected that traditional materials used for sewer construction will change substantially in the near future. However, the continuing competition by suppliers of alternate materials used in collection systems will continue to result in improved performance and ease of construction and maintenance.

2.3.3 Treatment and Disposal

As a result of the Canada-U.S.A. Great Lakes Agreement, much stricter standards for industrial and municipal effluents draining to Lake Ontario have been established, and steps are presently being taken to construct works necessary to meet these requirements. Many plants have already installed phosphorus removal equipment to achieve one of the aims of the Agreement, i.e. 80% removal of phosphorus from municipal wastes by 1975. Others, particularly those discharging to relatively small water bodies, are being required to install tertiary treatment facilities, primarily in the form of polishing filters. Carbon absorption columns are being considered to obtain an even higher degree of treatment prior to discharge to small or critical watercourses. The replacement of chlorine for the disinfection of waste waters with other methods such as ozone, radiation and ultraviolet light is being evaluated in order to reduce the adverse effect that chlorine may have on natural biological processes in the receiving water.

Much research is being carried out in the field of sludge disposal both in the United States and Canada. A new technique which involves heating the sludge to 2,000° F without exploding the methane gas produced, is being developed in Canada. The gas produced could provide energy while the residue could be used as a fertilizer or animal food. Experiments are being carried out into the use of sludge to create agricultural land by spreading it on unfertile lands such as coal tips and abandoned open pit mines.

Large scale spray irrigation installations, utilizing sewage effluent following various degrees of treatment, are being evaluated in the United States and smaller scale systems have been installed in Canada. In addition to the agricultural benefits, this practice also results in increased ground water recharge.

With the recent increased concern over energy conservation the more efficient use of the gaseous by-products of anaerobic decomposition is being investigated by many authorities.

2.3.4 Administration

Wherever feasible, controlling authorities are tending to encourage regional sewage schemes, with large regional treatment works, as opposed to numerous small separated systems servicing a particular municipality, each discharging effluent to a relatively small local watercourse or at several points along a major watercourse, Increased public awareness of the environment, development pressures, and complexities of treatment and disposal, have encouraged local authorities to willingly turn over much of the responsibility for pollution control to the more senior levels of government, particularly at the provincial level.

2.3.5 Location

Recent efforts to reduce costs of sewage collection systems have resulted in efforts to locate sanitary sewers, storm sewers, sometimes water mains and in a few cases other services, in a common trench. Such practices, generally including sanitary and storm sewers in common trench, have proved economical in the construction of services in new developments and are particularly feasible when bad ground conditions such as rock or high water table conditions are encountered. Common connections to more than one building can result in capital cost savings for many types of development. However, since the individual building owner is generally responsible for the connection, the sharing of responsibility in case of repairs can cause problems.

2.4 APPLICATION TO NORTH PICKERING

2.4.1 General

The use of garbage grinders for individual homes and apartment units should be seriously evaluated for use in North Pickering. The possibility of in-home separation of materials from solid waste has greatly increased recently and should this practice become popular the household garbage grinder with subsequent discharge to the municipal sanitary sewage system would be a feasible means of disposing of the putrescible portion of the garbage from residences.. The capability of the sewage collection system and the waste treatment facilities to handle the increased loads must also be considered.

Restrictions on industrial effluent quality and quantity which would necessitate, where feasible, the treatment and recycle of process waters could be implemented as a pilot type project for North Pickering. Such a policy would require the review and approval of proposed industrial process flow systems to ensure that all feasible process streams were recycled.

2.4.2 Collection

The low pressure sewage collection system may be feasible for certain areas of North Pickering where conventional gravity systems may be expensive due to environmental protection, low density development or deep sewer construction. The feasibility of its application to service major portions of the development however is doubtful. Maintenance of the system, especially the grinder pumps, could present substantial problems. It is likely that the capital cost savings in constructing the low pressure sewer system would be significantly less than a gravity sewer. However, operating and maintenance costs, particularly power costs for the pressure pumps, would be substantially greater than for gravity systems.

The vacuum system also holds promise and is especially adaptable to low or non-waterborne transmission such as might occur in combined collection of sanitary and solid wastes. However, further investigations into combined usage, operating costs and maintenance problems, will be necessary before the feasiblity of such a radically new collection system could be specifically evaluated for North Pickering. As with the low pressure system, there would likely be savings in capital cost but higher direct operating costs due to the power requirements as compared to conventional gravity sewer systems. If a vacuum system were to be used in North Pickering, it would be necessary to collect both black and grey water unless the grey water was recycled for secondary uses. One major maintenance problem apparently not yet satisfactorily solved in the vacuum system, is the tendency of the system to clog.

2.4.3 Treatment and Disposal

Wherever feasible in North Pickering all sanitary wastes should be directed to trunk sewers which will in turn transport the waste to the regional sewage treatment plant proposed at Duffin Creek. The plant type, location, and other details are beyond the scope of the report.

It may be feasible, in some isolated cases or as a temporary provision until regional facilities become available to install small local treatment or recycle facilities in areas somewhat out of reach of the major collection systems due to topographic, environmental or other reasons. Such plants would have very stringent effluent controls, to permit discharge to a local watercourse, storm sewers or by subsurface soil absorption . The possibility of using recycling plants, such as those previously mentioned to produce water for secondary uses, could also be feasible for remote areas.

The use of treated effluent and sludge for irrigation and fertilization of parkland, gardens or agricultural lands from the regional treatment plant or from any local treatment facilities should be considered feasible, subject to further study for the particular use in question.

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STORM WATER MANAGEMENT

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3.0 STORM WATER MANAGEMENT

3.1 INTRODUCTION

Precipitation, at rates or volumes, exceeding the surface detention or infiltration capacities of the surfaces upon which the precipitation fall, becomes storm water runoff. This storm water runoff when generated by large areas, impervious surfaces or intense rainfall can result in high rates of flow and can exceed the capacity of the natural drainage courses, causing inundation to some degree. On the micro scale, the ponding of water on areas of human activity such as parking areas, residential roads and lawns can occur and is considered undesirable. On the macro scale, peak flood flows in rivers and streams can cause extensive damage, inconvenience and loss of life. The gamut of storm water runoff control must be looked at on both the micro and macro scales as well as under natural and developed conditions.

Precipitation falls in many forms but all are in a relatively pure state until contacting the ground. Once upon the ground, the water becomes contaminated by both the substances that become dissolved and materials that are carried in suspension and by flotation. Storm water quality is substantially influenced by development in a watershed, both as to quality and quantity. Contaminants of various toxicity and concentration can be introduced to a watercourse by storm runoff. Also, development and construction techniques can increase flow rates and velocities of the storm waters which, together with increased sediment loads from denuded land, can have deleterious effects on watercourses downstream from the development. Storm water quality and storm water quantity are closely linked and should therefore be jointly considered in any discussion of storm water management.

3.2 CURRENT PRACTICE

3.2.1 REGULATING RESPONSIBILITIES

Under the provisions of the Province of Ontario's Conservation Authorities Act, 1971, for the purposes of accomplishing its objects, an Authority has the power "to control the flow of surface waters in order to prevent floods or pollution or to reduce the adverse effects thereof". It is under this provision that the province has delegated the regulatory powers for Storm Water Management to the Conservation Authorities and the Ministry of the Enviroment. In areas where Conservation Authorities have been established they are relatively autonomous whereas in other areas the Ministry of Natural Resources assumes the responsibility of administering the Act.

Regulatory responsibility takes two basic forms: pre-planning and post maintenance. Where watersheds are largely undeveloped, it is possible to develop and implement good storm water management policies to prevent adverse conditions from developing.

In developed watersheds where problems are often existing, the establishment of filling restrictions and the construction of erosion control works to prevent conditions from becoming worse are often undertaken by the Authorities.

Once planning policy has been developed on the large scale, the powers of approval, subject to the broad policies, are often delegated to local municipalities. This delegation of power often takes the form of floodline mapping projects whereby the floodline or extent of flooding expected, for the regional storm over the watershed, is delineated on a developed watershed basis and the municipality is allowed to approve plans subject to the constraints of the floodline map. Similarly, where large watercourses pass through major municipalities, a policy is usually established as to whether, where, how much and in what way additional storm runoof can be discharged to that watercourse.

The engineering design of physical storm drainage works is usually subject to municipal approval but approval in principle of most projects is required from the Conservation Authorities. The determination of water quality parameters is largely a Ministry of the Environment responsibility but often input is given by the Conservation Authorities. The water quality aspects of storm water runoff have not been given much importance in the past, however, an increasing awareness of storm water quality is presently developing and it appears that it will gain increased prominence in future years.

3.2.2 WATER QUANTITY & WATER QUALITY

The conventional approach to storm drainage from developed areas has been to convey the runoff water as quickly as possible to the nearest natural watercourse with sufficient outlet. This philosophy has resulted in increased peak flows and lower base flows in most natural watercourses through developed areas. Very little has been done to control the quality of the storm runoff waters through urban areas. Consequently, the pollution load from storm sewers can be very high. While erosion of, and sediment contribution from, agricultural lands has long been a concern, only recently has the sediment contribution from lands and roads under development been considered worthy of attention and in only a few projects have sediment removal ponds been provided.

The actual servicing techniques can be divided into two areas, surface and underground. Surface drainage via open ditches is losing popularity although in some residential areas collector ditches are used for relatively short distances. This is often referred to as a "Partial Storm Drainage System".

In a 100% storm drainage system, the following items contributing runoff are connected to underground storm sewers.

a) Streets - by means of catchbasins and connecting pipes.

b) Roofs of houses - by means of downspouts, some of which are connected to the storm sewer by underground house laterals.

c) Weeping tile around foundations - connected directly to the local storm sewer by gravity, with or without a check valve, or by the discharge from a sump pump into the local sewer.

d) Lawns, parks and parking areas - by grading so that the slope is directed towards driveways and stree curbs, or by the use of rear lot and parking area catchbasins which are connected to the storm sewer system.

The local storm sewers flow as directly as possible to the nearest natural watercourse with sufficient outlet capacity. Care is normally taken to provide an outlet structure where the sewer discharges into the watercouse, located and designed to minimize local erosion of the watercourse.

This conventional philosophy of disposing of storm runoff waters as quickly as possible has, in some cases, created problems in the natural watercourses into which this water is being discharged. Increases in peak flows by factors of 1.5 to 3.0 are not uncommon in developed areas. This increase in peak flow increases the flood and erosion potential of the watercourse. Increases in sediment load of the runoff waters increases the turbidity which is detrimental to many aquatic life forms, the settling out of these solids can reduce the flow capacity of the channel, excessive silt can accumulate at the mouth of the watercourse and the aquatic vegetation in the watercourse can be impaired. Storm water runoff is often quite contaminated and can contain considerable concentration of BOD, suspended solids and other pollutants. In many cases the storm drainage is in need of at least primary and possibly secondary treatment. It is thought by many that the next step in the pollution abatement process will be the cleanup or treatment of storm runoff waters particularly from urban areas.

3.3 INNOVATIONS

3.3.1 WATER QUANTITY & WATER QUALITY

There are two basis objectives that appear to be in the forefront of any discussion of storm water management. They are the reduction of the increases in peak flows in the receiving watercourses and the improvement of storm water quality. The reduction of runoff peaks can occur in many simple ways. Lot grading to utilize natural and artificial swales will increase the times of concentration, that is the time for the water to reach a given point in the drainage system. The discharging of roof downspouts to lawns instead of directly to the sewer can reduce the runoff coefficient of the roof from the impervious range (0.95) to the pervious range for the lawn (0.20) This also increases the time of concentration. In a similar manner foundation weeping tiles can be drained to a sump and pumped to sodded areas, thus, eliminating the need for a house connection to the storm sewer. Precautions must be taken in the winter to ensure that freezing of the outlet does not cause problems.

On a larger scale the reduction of peak flows and even some improvement in the quality of the storm waters, can be accomplished by the use of on-site detention storage. Detention of storm water runoff at or near the point where raindrops impact can be a most economical means for handling runoff in urban land developments. The detention method most often being implemented today involves ponding runoff in open spaces and parks, parking lots and on commercial plazas and horizontal roofs of buildings. Gravity release of stored runoff into the collection drainage system is controlled by simple flow regulators such as weirs, orifice plates, spillways and pipes. Where gravity release is not possible, the runoff can be pumped from storage at predetermined rates. It is also possible to design these detention storage areas as artificial permanent lakes and as sediment removal ponds.

Under the Planning Act of Ontario, it is necessary for the subdivider to dedicate at least 5% of the gross area of the land to the municipality for parkland or other municipal purposes. In subdivisions of 50 acres and more, the land dedication could be put to a very practical use by creating small artificial lakes or temporary depression storage areas which would form part of the storm sewer system. This innovation will affect open space planning and overall density considerations.

The effectiveness of sediment removal ponds becomes subject to the periodic cleaning or removal of the settled sediments. Maintenance of any pollution control facility is always necessary to retain the design efficiency of the works.

Thought and research is also being directed toward the use of combined sanitary and storm sewers for reasons of economics and due to the need for treatment of some urban storm waters, Further study is required into the feasibility of constructing holding or surge tanks within the system and treating both storm water and sanitary sewage at the treatment plant during the off peak hours. In any event the reduction of the volumes and peak flows of the storm runoff would have benefits in many areas. The Federal Department of the Environment in co-operation with the Ontario Ministry of the Environment are currently sponsoring studies to evaluate the feasibility of treating storm runoff.

3.3.2 ECONOMIC CONSIDERATIONS

The conflict between economic and enviromental considerations is consuming an ever-increasing proportion of the decision making and design process when developing land. It must be realized that in any development, the amount and rate of runoff will be increased and its quality degraded. It should be the aim of planners and designers to employ an optimum combination of environmental and economic considerations.

The treatment of storm runoff waters is a costly proposition and this must be weighed against the effects of the untreated storm runoff waters on watercourses. The construction of detention storage facilities can also be costly if required for implementation after initial construction of a development whereas in several new developments in the U.S., the natural drainage or detention storage design philosophy has resulted in a significant savings in the capital costs for storm drainage construction.

Development of additional lands is required to provide housing and employment for our growing population and therefore some degree of environmental degradation must be expected and accommodated. However, attempts must be made to minimize the enviromental and sociological considerations.

3.3.3 SELECTION OF DESIGN CRITERIA

It is felt that even a single flooding of a basement during the "life-span" of a house is not acceptable but that fairly frequent inundations of streets is tolerable. It would then seem to be quite acceptable to design storm sewers to accommodate a 2-year probable return storm, have no house connections and construct the storm sewers at elevations just sufficiently deep to receive storm water runoff from the street catchbasins. The cost of installing sump pumping facilities in every basement would be more than offset by the reduction in capital costs of building smaller, shallower storm sewers in many cases.

Storm drainage of larger areas should take into consideration the possible effects of storms of longer return period to prevent possible damage due to infrequent deeper inundation.

Rather than developing a specific set of design criteria for different conditions, each design situation must be approached on an individual basis with respect to relating design storm inconvenience and potential damage from flooding.

3.4 APPLICATION TO NORTH PICKERING

The proposed North Pickering Project can affect 4 main watersheds, Little Rouge Creek, Petticoat Creek, West Duffin Creek and Duffin Creek. Only small parcels of land located primarily at the outlets of these watersheds have as yet been developed and the majority of the lands are either largely unused or farmed. The river valleys are presently in a relatively steady state condition where only slow naturally-occuring geomorphological processes are occurring. The North Pickering Project could develop a significant percentage of these watersheds and the construction of the proposed second Toronto airport would result in a major development of these watersheds.

The aspects of this large scale rapid development on the existing natural environment of the watercourses can only be appreciated if a comparison is made to other developed watersheds in 'before and after' development state. Peak flows might be expected to increase by factors of 1.5 to 3.0 and water quality to decrease substantially if conventional philosophies and techniques of storm drainage are used. The environmental sensitivity of these water courses will weigh heavily in the determination of what increases in peak flows and decreases in water quality will be allowed for in the final design for development. The determination of these design parameters will dictate what methods of storm drainage can be or must be used.

Innovative storm drainage design to minimize environmental impact and prevent serious maintenance problems, as have occurred on occasion in the past, will find wide usage in the design of North Pickering where a before-the-fact approach can be taken to implement watershed management philosophies for the area.

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STATE of the ART REPORTS

SOLID WASTE MANAGEMENT

4

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4.0 SOLID WASTE MANAGEMENT

4.1 INTRODUCTION

The report addresses itself to the current practices and immovations in the general areas of solid waste generation, collection/transportation, processing/disposal, reclamation/ recycle/ energy, and administration. The state of the art of solid waste management is changing very rapidly, and by the time North Pickering comes under detailed design, additional data on some of the innovative solid waste management systems currently under active study will most certainly be available. Thus, although this report does comment on the application of current practice and innovative techniques to North Pickering, it is recommended even more so than other services that the applicability of the alternate solid waste management systems available be reviewed prior to implementation of any one system.

4.2 CURRENT PRACTICE

4.2.1 GENERAL

Historically, the management of solid waste has not received a prominent position in the considerations of communal responsibilities, a matter of expediency rather than of sound and established practices. The major concern involving collection and disposal has been related to economy and to a lesser extent to health factors. Little attention was given to aesthetics, environmental degradation, and except in times of extreme need, to recovery of materials.

Technologically, solid waste management has progressed little beyond the common sanitary landfill and incineration practices. In North America, even these methods are considered an advancement where, as late as 1967, only 6% of all landfill disposal sites could be classified as "sanitary" and where the primitive methods of open dumping, open burning and sea disposal were a common and accepted practice. Incineration has proved to be a costly alternative, strictly in terms of capital and operating costs, without consideration of the insult to the immediate environment due to air pollution, and therefore, was usually found to be prohibitive to all but the largest municipalities.

Recently, alternatives to the traditional practices have been explored by both government and private industry to ease the solid waste problems created by increasing urban population, decreasing availability of disposal sites, stricter air emisson controls and loss of potential resources. The United States for example, through the Environmental Protection Agency (EPA) has instituted a massive data and information centre and has

provided substantial funds for research and development into various aspects of solid waste management systems. While the Canadian experience has been limited, due mainly to a less critical situation than in the U.S., useful information,' nonetheless, is being generated for the improvement of current management practices. In Ontario, the Ministry of the Environment has recently commenced supporting studies of innovative solid waste management systems. For the purposes of this report, a solid waste management system may be considered to consist of four primary components, generation, collection/transportation, processing/disposal, and reclamation/recycle/energy.

4.2.2 GENERATION

The most critical element of a solid waste management system, one which is too often overlooked and usually disregarded entirely, is the generation characteristics of a given area. Generation can be regarded as the "use" element of the management system for a particular material, as opposed to the "after-use", which refers to the remaining components such as collection, transportation, processing and disposal. The analysis of the generation characteristics then becomes the basis for evaluation of current practices and facilities and is the major criterion in the development of proposed alternatives. The importance of accurate data and forecasts cannot be overstressed.

While comprehensive data is lacking for specific areas, and parameters influencing generation are little understood, some factors nonetheless may be easily delineated. For instance in any given municipal sector, such variables as seasonal changes, fauna, socio-economic status, local bylaws, industrial development, existing disposal facilities, and legislative action can affect the qualitative and quantitative aspects of solid waste. Thus, the popular consesus that 5 lbs. per capita per day is generated in North America and that this figure is expected to rise to 8 lbs. per capita per day has little local significance. Furthermore, the figure is the amount of solid waste collected rather than generated and does not include non-collected industrial wastes, institutional wastes, or non-municipal wastes such as mine tailings and agricultural wastes.

A compilation of the percentage composition of municipally collected waste on a dry basis is shown in the following table for specific areas in North America. As well as the factors listed above, differences in composition occur because of inconsistent sampling techniques, including the length of survey, time of year, refuse sorting, local collection practices, and the use of home garbage grinders.

4.2.3 COLLECTION/TRANSPORTATION

The collection/transportation element of a municipal solid waste management system regularly incurs approximately 3/4 of the total direct costs, irrespective of the disposal practices. Various collection systems have been attempted including a variety of source and transport containers, household compactors, one-man pick-up systems and transfer-haul alternatives.

There are various transportation modes available including trucks, trains, pipelines and in particular cases, airplanes and barges. In many areas of North America, sewer lines are used to transport the kitchen wastes. In general, however, costs have reamined relatively stable for a specific area, in the wide range of $5 to $25 per ton of waste, with little savings realized from the different methods. The benefits from the newer methods have inclueded easier handling with the introduction of plastic bags, fewer health problems with closed containers, greater volume handled with compactor trucks and transfer-haul alternatives.

4.2.4 PROCESSING/DISPOSAL

The most extensively accepted engineered processing/disposal methods in North America are sanitary landfill and incineration. No discussion is necessary on the aspects of questionable practices such as open burning, uncontrolled dumps, and ocean disposal.

Sanitary landfill is probably the most economical in terms of direct costs and the simplest of all engineered practices. As defined, it is a method where refuse is dumped, levelled, and covered with a layer of dirt after the day's operation, thus minimizing health hazards, while allowing marginal or waste lands to be reclaimed for useful purposes. Recently, however, some municipalities have found land suitable for landfill sites exceedingly difficult to obtain and farther from the urban core, resulting in increased costs in transportation and disposal and negating the economy of the method. In addition, concerned citizens have not found the practice to be totally justifiable with respect to lost resources and potential damage to the environment.

Minor modifications such as shredding and baling of refuse,can increase the life of landfill sites and decrease transportation costs but have failed to solve other difficulties. It can therefore be expected that in the future, any disposal system which recommends landfill as the major long term processing/disposal policy will encounter problems with public acceptance.

Incineration, a process of controlled burning of refuse, is another commonly accepted practice. While the method alleviates some of the problems associated with sanitary landfill, it has a major disadvantage in addition to the loss of recoverable materials, in that expensive air emission equipment is necessary to meet increasingly strict air pollution standards. Thus, with these costs rising steadily, the future prospects for incineration of solid waste without product recovery, such as waste heat or metals is also liable to encounter strong opposition.

4.2.5 RECLAMATION/RECYCLE/ENERGY

At the present time, the reclamation and recycle elements of municipal solid waste management systems are severely limited by a number of factors. Among the most significant are marketing problems associated with recovered materials and general skepticism regarding existing recovery machinery. In some areas, notably Atlanta, magnetic separators have been reclaiming ferrous metals from mixes municipal refuse for over 35 years. Hamilton's new incinerator, the SWARU, is now recovering ferrous metals and is marketing the material to a nearby detinning plant. In most instances, however, recovery of materials is hampered by lack of outlets for them, the best example being the numerous composting plants in the U.S. that have ceased operations primarily because of marketing problems.

Most of the after-use recycling and reclamation is accomplished by volunteer groups, by manufacturers of disposable products, and in a few instances, due to bylaws which require separation of certain materials such as paper, at the source of generation, namely the household. Although this may separate some of the solid wastes, it does not in any way guarantee that recycling will occur, given the present market situation. In fact, examples of well-intentioned volunteer groups, who have collected recovered materials but were dismayed to find no one able to dispose of them despite advertising campaigns to the contrary, are wee-documented. The marketing situation should improve, however, with industry realizing the potential for recovered resources and with improved extraction machinery. Nonetheless, before industry is willing to accept recovered materials for recycling, a stable and dependable sources of supply must be assured.

Energy recovery has received even less consideration in the past than reclamation and recycle, although in Europe, mixed refuse has proved to be an adequate fuel, supplementing coal in the generation of electricity, and refuse incinerators have provided heat and steam for nearby communities and institutions. In North America, steam gereration from waste heat is practised in several areas, Chicago being the largest operation.

4.2.6 ADMINISTRATION

At present, the direction for management and legislative action pertaining to disposal of solid waste in Ontario is under the authority of the provincial Ministry of the Environment.

Local authorities are responsible for the collection and transportation of solid waste and for operation of disposal facilities, following guidelines set forth by the Province.

The Federal Government through the Department of the Environment has recently formed a Solid Waste Management Branch. Under the direction of this Branch the Federal Government is becoming involved in research and development of innovative solid waste management systems in co-operation with the provinces.

One major dilemma which requires immediate resolution is the role whch the government authorities are to play in the recycling and recovery of materials from municipal solid waste. Traditionally, governments have shown reluctance in becoming involved in matters of marketing and private enterprise. This is further complicated by possible loss of authority if private firms were to control part or all of the management system. While this is a problem of management structure and policy, it nevertheless contributes to the retardation of purposeful action.

4.3 INNOVATIONS

4.3.1 GENERAL

While solid waste management practives have not, on the whole altered greatly in the past few years, several innovative and promising systems have been suggested. As more data is generated on synthesized systems and unit processes, this information will provide a new direction and approach to solid waste management. Recognition of resources lost through present practices and rising costs of traditional methods because of precautionary measures taken to curtail environmental degradation, coupled with promising innovations, have created an atmosphere of expectation for an immediate solution to the problems of solid waste. It must be taken in the correct context, however, with evaluations based on a total, comprehensive and objective formula, without allusion to panaceas.

4.3.2 GENERATION

Although generation of solid waste can be roughly projected over a short period of time, the factors which can affect generation characteristics should be of prime consideration. Possible legislation affecting generation include: banning of non-returnables, namely cans and bottles; tax incentives for secondary materials industries; percentage inclusion of recycled materials in newly produced products; tighter controls on packaging industry to reduce excess packaging; source separation and separate collection of some wastes such as paper, cans and glass; penalties or incentives for recyclability of products; subsidies for transportation of recovered materials; policies governing disposal practices; use of household garbage grinders. In addition, raw material resources depletion, energy conservation, substantive data on innovative methods, rising costs of traditional disposal methods, and collection/transportation changes can all directly or indirectly affect generation practices. It should be realized that the more successful the after-use practices, that is the processing/reclamation/disposal, the less likely that waste reduction or reclamation will occur at the generation stage.

4.3.3 COLLECTION/TRANSPORTATION

Recent innovations in collection and transportation are not extensive but a few methods deserve consideration. One interesting method which presently appears limited to more densely developed areas is the pneumatic or vacuum tube transport system. Sweden is currently active in developing the vacuum system for high density developments and hospitals and has expanded this interest to other countries. One of the first installations in North America was for Walt Disney World in Florida where up to 50 tons of refuse per day are collected. A similar system was also installed in a residential and hospital community for Welfare Island, N.Y. to serve 20,000 people. The system is reported to be uneconomical for single family residential development or for any development where buildings are widely scattered. A density, equivalent to at least 20 family-units per acre has been stated as the point at which such systems begin to become economical.

Collection from individual households by a vacuum method installed in collection vehicles has been suggested by Aeroject-General Corporation, a subsidiary of General Tire which holds the American Rights to the Swedish tube transport. The system replaces manual handling thus reducing health and safety hazards, fly and rodent problems.

Various innovative methods have been attempted to collect solid wastes which have been separated at the source into various components such as paper, cans, bottles and putrescibles. Individual collections at different times for each component is inconvenient to the householder and as a result co-operation is poor. Separate trucks for each component require additional crews and machinery which greatly increases costs. The piggy-back system, with separate containers on each truck for each component collected, reduces the cost of separate truck pickup but still requires additional pickup crew and increases pickup time. Modified collection vehicles are available which can accommodate separate wastes.

Continued development of more sophisticated equipment such as the vacuum collection truck and higher density compactor trucks will result in more efficient collection practices. At present, it appears that the most feasible area for reduction of the high cost of collection and transportation lies in reducing the volume of refuse handled. Aside from decreased waste generation, one promising alternative is the increased use of the home garbage grinder. These units, installed in every household, would effectively eliminate the putrescible fraction of the solid waste, currently at least 30% by weight of the total generated. Several advantages arise from this, the most salient being that recovery and disposal processes of the remaining solid waste fraction would be greatly facilitated. The remaining waste is low in moisture content, without odour and accompanying pests, and would reduce some of the nuisance problems now encountered with sanitary landfill. The disadvantages include greater load on sewage systems and slightly higher (2% to 3%) water consumption.

While it is evident that savings can be realized from selected collection/transportation methods, analysis must also occur within a framework which extends beyond direct costs and include factors such as energy consumption, labout needs, social impact, future adaptive capabilities, and assimilative capacity with other elements of the system. For example, source separation, with associated increased collection costs, may be a more feasible overall system than sophisticated processing/ reclamation recycle facilities,to separate mixed refuse.

4.3.4 PROCESSING/DISPOSAL

Shredding and/or baling of solid waste prior to disposal reduces many of the nuisance problems associated with sanitary landfill, increases the carrying capability of transportation facilities and the disposal capability of the landfill sites. Advances in sanitary landfill design, including sealing methods using artificial membranes or clay liners, leachate collection and treatment facilities, gas collection and venting systems, all can assist in reducing the adverse effects of sanitary landfilling on the environment.

Recently, efforts have been made to collect and market the methane gas produced in sanitary landfills.

Advances in air pollution control equipment and improved air pollution regulations will also reduce the adverse effects that incinerators have had on the environment.

Most of the innovative methods of processing and disposal involve recovery of certain materials or energy, and are referred to in the following section. It must be noted, however, that all of the innovative material or energy recovery systems still require an ultimate disposal facility whether it be sanitary landfill for ashes, putrescibles and unrecoverable inerts, or markets for the reclaimed materials.

4.3.5 RECLAMATION/RECYCLE/ENERGY

Recent concern about depletion of non-renewable resources has focused attention on making more efficient use of such resources by reclaiming materials or energy from solid waste. Energy can be recovered both by reclaiming energy intensive materials such as aluminium, paper and glass from solid wastes or by using putrescibles as a fuelfor one of the many energy recovery systems. Direct reclamation of non-renewable minerals such as copper, nickel, iron, tin, etc. from solid waste is also an important consideration. Numerous studies, research projects and pilot plant tests into reclamation, recycle, and energy recovery are presently underway and innovative information is being published almost daily. Based on a literature search and conversation with personnel in the field, a brief description follows on systems which appear at present to have promise.

a) Energy Recovery - Water wall incinerators, burning municipal solid waste to produce steam for district heating and colling purposes are the most popular type of incinerator used for energy recovery. Such units have been used extensively in Europe and more recently are coming into use in North America. The Chicago Northwest plant which went on-line in 1971 to handle 1600 tons per day is the largest. Other installations are either planned, under construction, or in operation in a number of North American cities including Harrisburg Pennsylvania, Nashville Tennessee, Akron Ohio and Quebec City. As an alternative to using steam directly for district heating or cooling it can be used to power onsite turbines to generate electricity.

Solid wastes can also be used as a supplementary fuel to coal or oil in an electrical utility boiler. The City of St. Louis is utilizing shredded combustible refuse to supplement coal up to a heat value of 20 per cent in an electrical utility boiler. In Ontario the Ministry of the Environment in co-operation with Ontario Hydro, Metro Toronto and the Borough of Etobicoke, have proposed utilizing solid waste as a supplemental fuel to coal in the Lakeview Generating Station. A two-year experimental program commencing in about 3 years will utilize approximately 500 tons of solid waste per day to operate oneof the eight Lakeview boilers. Material recovery systems to remove non-combustibles from the waste stream prior to burning are generally required to prevent excessive corrosion and jamming of certain fuel feeding mechanisms and are desirable from the material recovery viewpoint.

Possibly the most promising of all energy recovery processes from solid waste is the pyrolysis process which is essentially the thermal breakdown of material in the absence or near absence of oxygen. Useful fuels in the form of low BTU gases, oil, tar or char are produced. The process, of which there are many variations, is basically self-sustaining reqiring no external energy except for start-up and is virtually pollution free. Baltimore has begun construction of a full-scale pyrolysis plant employing the Landgard-Monsanto system, which upon completion in the summer of 1974 will pyrolyze 1000 tons of refuse per day and will provide valuable and needed information on large-scale operations. Recently, the State of Connecticut has passed legislation which in effect proposes pyrolysis as the only process for long term disposal of the State's solid waste. Biochemical processes involving anaerobic digestion of solid wastes, analogous to sewage sludge anaerobic digestion to produce methane gas, are being developed. Most processes under development are proprietary and little data is available.

b) Materials Recovery - Materials recovery can be performed by wet or dry processing of solid waste and can precede energy recovery systems.

The Black Clawson Hydrasposal/Fibreclaim process is an example of the wet separation method where water is added and the refuse ground to a slurry. Materials recovered include metals, glass, and organics in the form of pulp. The pulp can then be utilized as a fuel upon drying, or as material for production of paper and allied products.

Many dry material recovery techniques have been developed and tested. Most require shredding prior to recovery of components by a variety of processes including magnetic separation, air classification, flotation, screening and optical separation. The Ontario Government is presently carrying out a preliminary

engineering design of a pilot scale materials recovery plant to be located at one of the sanitary landfill sites in the Toronto area. The results of this study are not yet available.

Composting involves the biological degradation of organic material in the solid wastes into a humus-like material which is useful as a soil conditioner or a feedstock for fertilizer manufacturers or other higher value products such as wall board. Most composting operations in North America have proven uneconomic due mainly to marketing problems with the finished compost. The technology appears well developed and if marketing problems could be overcome, composting offers a good solution not only to the treatment of solid wastes but to upgrading of marginal agricultural lands. It would be especially applicable to communities surrounded by large tracts of undeveloped poor quality land.

4.3.6 ADMINISTRATION

A more defined administrative structure, perhaps incorporating all services; policies governing allocation of monies; and defining the role of private enterprise is desirable. The administration must be able to function in interdisciplinary roles such as encountered with burning of refuse for electrical generation. Moreover, external relationships with other government agencies, service, volunteer and private groups, associations, and societies who have identifiable interests in solid waste, must be met. Included are the Department of Health, Conservation Authorities, Wildlife Associations, Audubon Society, Pollution Probe, Solid Waste Contractors Association, etc. The Administrative structure must be flexible enough to allow inputs and dialogue from these and other interested groups.

4.4 APPLICATION TO NORTH PICKERING

4.4.1 GENERAL

The Ministry of the Environment is currently studying the feasibility of a reclamation plant, and another study on generation of electricity from solid waste has recently been completed. These studies will form the basis for direction of future solid waste management programs in Ontario.

While feasibility can be expressed in terms of traditional economic and technical factors of a given system, other considerations have become a prerequisite before acceptance and approval. Social factors, including neighbourhood degradation, noise, sight and traffic; health factors; raw resources depletion and energy considerations have increased in importance in the evaluation of alternatives.

Because of the many systems available, and with the implications of each open to question, the optimum feasible system of process, reclamation and disposal would be difficult, it not impossible to delineate. Therefore, a systems approach which embodies rankings of each synthesized system under calculable factors (economics, technical considerations) and subjective factors (generation characteristics, implications of legislation, resource depletion, citizen's willingness to pay, etc) is suggested. The methodology for systems analysis, however, has not as yet been sufficiently thoroughly established to be applicable for all geographical areas. None the less, it would be in the interests of North Pickering to develop one from basics or to modify one of the existing methodologies.

4.4.2 TECHNICAL

In general, all the present practices and innovations are technically feasible, subject to engineering constraints. While these constraints may seem trivial, in fact they may prove to be the major deterrent in complete rejection of a proposal. For instance, sanitary landfill, while simple to establish, has implications of leachate and gas productions which may not be completely solvable. Incineration, with attendant recovery of heat, has encountered problems with fee material and slag, not to mention marketing of the reclaimed steam and installation of air emission control equipment. The innovative methods have problems of substantive technical data which are lacking because they are presently operating under experimental and pilot plant conditions. Other minor problems occur such as differences in material composition and required equipment modifications, that impede acceptance of methods. The general consensus, however, is that technical problems with innovative processing and disposal methods per se can be overcome. The associated uncertainties such as dependable and sufficient raw product supply, uniform quality of the materials or energy recovered, and the development and stability of markets for the products may be more difficult to solve under present administrative practices and cannot be approached only at the local level.

4.4.3 ECONOMIC FEASIBILITY

Economics in the past has been the major consideration in the selection of a solid waste management system. However, with the decrease in available landfill sites, increased costs of incineration and realization that reclamation and recovery are desirable, the economics of process and disposal has assumed a lesser role. Although sanitary landfill offers the most economical of all methods, costs are still increasing in view of the total system. For example, as available sites are depleted, transportation costs increase.

The attractiveness of innovative methods, and recycling and recovery, lie in the fact that the traditional methods are antiquated and prone to pollution hazards, and that successful marketing of recovered materials may in fact allow municipalities to reduce the direct costs of more sophisticated systems. Although income derived from recovered materials should not be the major economic consideration, it is nevertheless a sound basis for adoption of a particular system if markets can be assured.

It is important to reiterate that costs for processing and disposal, while varying greatly, are dependent on geographical location and existence of markets for recovered materials. In general, sanitary landfills can cost upwards of $5 per ton excluding transportation costs and on-site pollution abatement equipment; incineration upwards of $10 per ton; pyrolysis $10 per ton excluding sale of recovered materials. If costs continue to rise for traditional methods and raw resources, it can be expected that recovery methods and innovative processes will be much more suitable for consideration.

COMPOSITION OF DOMESTIC WASTES
(from Clark & Brown's
Municipal Waste Disposal)

SOURCE	PER CENT BY WEIGHT - DRY BASIS									
	METALS	CLOTH	PLASTICS	RUBBER	GLASS	WOOD	GARBAGE	PAPER	INERTS	TOTAL
San Diego[1]	9.15	3.84	0.32	5.13	9.95	8.0	0.41	50.74	22.45	100.0
Montreal[2]	8.6		5.70		3.9		18.8	50.1	12.9	100.0
California[2]	10.7		1.6		11.7		68.4		7.6	100.0
California[3]	7.0	4.0	1.90	1.1	8.0	2.0	15.5	51.5	5.0	100.0
Johnson City[4]	15.0	1.3		1.5	7.0	0.3	22.8	59.8	0.6	108.3
Gainsville[4]	7.55	2.10		2.77	6.54	0.13	21.85	53.53	5.56	100.0
Mobile[5]	8.0	0.80			7.0		35.6	39.7	8.9	100.0
Raleigh[6]										
i) Income >$7,000	6.7	2.07			14.4		26.36	47.23	2.07	100.0
ii) Income <$7,000	7.9	4.13			11.0		35.94	39.43	2.90	101.3
Toronto[7]	5.9	1.50	2.60		8.0	1.10	38.90	39.50	2.50	100.0

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WATER CONSERVATION and REUSE

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5.0 WATER CONSERVATION & REUSE

5.1 INTRODUCTION

Historically, water has been thought of as a "free good", a resource with limited dollar value and available to every being. With extensive supplies of fresh water in Canada, and the relatively low cost of this resource to the individual, little consideration has been afforded until recently to conservation or reuse of water.

5.2 CURRENT PRACTICE

5.2.1 General

Even in areas where water is in short supply and where reuse has been suggested as a means to increase the supply, public acceptance has been in question. Direct renovation and reuse therefore, has been practised primarily within the industrial sector and domestically in only a few areas of the world, where water supply is in acute shortage. In most cases, efforts have been directed towards development of new and larger sources of supply, and in curtailing consumption, rather than in conservation and reuse.

Indirect reuse of water, following treatment of waste water and dilution in receiving waters, however, is universally practised, albeit unknowingly in many cases, throughout the world.

5.2.2 Uses/Quality

Normally, water supplied in municipal water distribution systems is of a high uniform drinking quality, although during peak fire demands less treatment is sometimes given to the water. No quality distinctions are normally made as to its end use, whether it would be for lawn-watering, washing or drinking. Only in isolated instances, have communities developed a separate distribution system for lower quality water use for such applications as horticulture and fire-fighting.

Both domestic per capita water demand and industrial water demand per production unit are generally increasing. This increase basically can be attributed to a higher

per capita disposable income. The resultant higher standard of living, results in increased water use for such reasons as more bathrooms, swimming pools, lawn-watering, high water-use appliances such as dishwashers, air conditioners and water-based recreational activities. Increased industrial water demand results from demands for more refined products such as higher octane gasoline. Conversely decreased industrial unit demand for water occurs through better processing technology. The incentive to reuse or conserve industrial water has usually been the result of increased emphasis on pollution abatement programs rather than for water supply reasons.

5.2.3. Methods

Water conservation and reuse embodies two basic principles. The first is actual reduction in water consumption such as limiting lawn-watering, building bylaws or plumbing restrictions on number or type of fixtures, and increased water rates. The second is actual direct reuse of water, primarily by industry in recirculating cooling waters or recycling process waters after conventional treatment processes. There are other indirect examples of water conservation such as the construction of reservoirs, dams, or large bodies of water primarily for flood control or power supply purposes to store water from periods of high runoff for use during drier periods. These practices also provide water for recreational use such as fishing, swimming or boating and provide surfaces from which increased evaporation can occur for subsequent precipitation in other areas. Generally, however, where adequate supplies of water exist, little effort is expended in conscious direct conservation or reuse of water and little attempt is made at altering the historical perspective of water as a "free good".

5.2.4 Controls

Pricing policies for water, the extent and nature of metering, subsidies and water quality standards, all affect the consumption or the pervasiveness of conservation and reuse of water. Pricing, on the whole, has not been used extensively to control demand. In fact, most water utilities have a decreasing rate structure with increased demand and government subsidies are granted to develop water supply projects, thus obscuring the true cost to the user. In general, the low cost of water to the user has created an atmosphere where incentive for reduction in consumption or for encouragement of reuse and recycle practices is not fostered to any degree.

5.2.5 Administration

The Ontario Ministry of the Environment sets water quality standards for both ground and surface waters and is responsible for enforcing the requirements. In general, individual municipal or regional governments are responsible for water supply and distribution for industrial and domestic purposes within their jurisdiction. In many municipalities the Ministry of the Environment is also responsible for the operation of supply and distribution systems as a result of provincial financing of the works. Regional Conservation Authorities, under the direction of the Conservation Authorities Branch of the Ministry of Natural resources, are responsible for certain watersheds within their areas and control water works which could affect the characteristics of these watersheds. The Regional Medical Officers of Health working within the jurisdiction of the Ministry of Health are responsible for the safety of waters used for public consumption in private residences, offices, industrial and commercial establishments.

Depending upon the type of water conservation or reuse system, most or possibly all of the above agencies would be involved in design, approval, construction and operation.

5.3 INNOVATIONS

5.3.1 General

There are a variety of innovations in waste treatment and water treatment technology which make reuse of water feasible under certain conditions and for specific uses. However, pollution control, rather than conservation or direct reuse of water, has been the primary objective in developing technology in most instances.

It is reported that approximately one-third of the electrical power generated in the United States in 1970, was used to supply water to cities and industry. Thus, conserving water directly relates to conserving energy.

5.3.2 Uses/Quality

Current drinking water standards are not applicable to the direct reuse of reclaimed waste waters for drinking since the potential for toxic substances is high and variable, failsafe treatment devices have not been

developed and monitoring for the low levels of toxic substances is not adequate for quality control. It is generally agreed that the reclamation of waste water for direct reuse in domestic drinking water systems is unwarranted and undesirable except in extreme cases where water is otherwise unavailable. In areas where there is an abundant supply of water, not even necessarily of high quality, economics preclude the use of waste water for domestic supply.

There is, however, great potential in urban areas and their immediate environs for use of water of lesser quality, such as industrial uses for process and cooling, irrigation, large scale cleansing operations such as for streets or automobiles, recreation and the creation of aesthetically pleasing water bodies. Since high quality drinking waters are now being used for these purposes, the extent to which water reuse and conservation measures could reduce the demand for fresh water can be readily appreciated.

Industries with external pressures to decrease pollution from effluents have in many instances initiated in-plant systems for reclamation, recycle and recirculation. There remains, however, considerable research and co-ordination necessary prior to the establishment of alternate standards for secondary uses of water for domestic use.

5.3.3 Methods

Methods of conservation and reuse of water can be divided into three categories: individual, local and regional alternatives.

a) Individual: At the individual household unit level, toilet flushing by compressed air will reduce usage by up to 5 gallons per flush or up to 60% of total household water consumption. Modified designs for water toilet flushing are available to reduce water consumption to as low as 1/4 gallon per flush. Recycle of partially treated black water through a separate individual house or building water system for toilet flushing has been considered. Incineration of toilet wastes employing natural gas or fuel oil is also a possibility with the waste heat employed to either heat the home or the water. The Ontario Research Foundation is carrying out studies on a washing device which will allow for more efficient use of water in households and reduce the per capita consumption. Other methods for conservation and reuse include: collection and use of rain water

for car-washing, lawn-watering, toilet flushing and laundry; flow controls to limit peak rate usage; and restrictions in type or number of water wasting fixtures or appliances.

b) Local: Collection of rain water, or treated effluent from industrial or municipal pollution control processes, for secondary usage such as fire-fighting or lawn-watering by using separate water distribution systems has been proposed for several locations. Community recycling schemes, such as those studies carried out by the Ontario Research Foundation for apartment buildings, which employ advanced waste water treatment technology show that complete recycling and reuse is possible and feasible under pilot plant conditions. Vacuum transportation of sewage could overcome possible sewer system problems which could result from low water volumes if individual or local recycling systems become popular. In areas where water conservation is an important consideration, local and regional parks could be used to collect and store rain water for irrigation purposes during dry weather.

c) Regional: At the regional level, recharge of aquifers with storm water or effluents by spray irrigation or underground storage in porous strata have been attempted in areas of low water supplies. Winhock, South Africa currently replenishes 1/3 of its domestic supplies with highly treated sewage effluent. A multi-purpose engineered and regulated waterway which could employ one stream for use as a water supply and recreational resource and another for waste collection has been suggested. Without altering actual per capita consumption, such practices as eliminating or reducing leaks, thereby increasing efficiency in the distribution system can significantly conserve water. For example, Chicago in 1961 lost 830 MGD through leaks, an amount more than twice as great as was consumed in Toronto. Other regional alternatives include retention of run-off water, rain water and effluent water, for secondary uses such as fire-fighting, toilet flushing and lawn-watering.

5.3.4 Controls

Control by legislation is an effective method of reducing consumption and encouraging reuse. Industry for example

could be required by legislation to recycle a portion of the water used. This together with tighter controls and standards for effluent discharges could substantially reduce industrial water use. Regulations restricting time and/or length of lawn-watering, decrease in pressures at peak periods, increased charges for water during maximum demand periods all are policies which, while tending to be unacceptable where water is plentiful, are nonetheless feasible. Probably the most effective means of conserving water would be to increase the cost of the product to the consumer. Even in municipalities where water is metered, generally a fixed rate is charged for a given number of gallons and for consumption exceeding this, the rate decreases with increased usage. This practice encourages increased water consumption and reduces incentives to limit use.

High water quality standards set for potable water are usually unnecessary for non-potable uses such as lawn-watering, recreational use and firefighting. Alternately, revised standards for potable water derived from waste water need to be established since existing standards assume that the supply source is relatively uncontaminated.

5.4 APPLICATION TO NORTH PICKERING

5.4.1 General

The feasibility of water conservation and reuse is highly dependent on availability of water and economics of supply. The more abundant the water supply, the less likelihood that any extensive conservation or reuse will be practised. Nonetheless, with the increasing water demand, pollution control restrictions, and energy conservation requirements, direct reuse of water may become practical even in areas of plentiful supply of water.

Since North Pickering is only a few miles away from one of the largest fresh water supplies on earth, many water conservation and reuse measures will neither be economically feasible nor generally acceptable.

At this time it does not appear feasible to implement, on an extensive scale, any of the innovative processes available for direct reuse of water in North Pickering. Conservation measures which discourage excessive water consumption, take advantage of the different quality standards for different water uses by multiple use, and emphasize greater efficiency in transporting and distributing water should, however, be applied to North Pickering.

5.4.2 Specific Applications

Multi-purpose use of water related facilities should be closely evaluated during planning and design. For example, the recreational potential of flood control works, the aesthetic value of storm water retention ponds and the aquifer recharge value of storm water runoff works should all receive consideration.

Legislation requiring the use of low or zero water demand toilets, low water use fixtures, revised water quality standards for secondary uses or mandatory recycling of industrial water would be difficult to introduce only for North Pickering. Areas or specific developments in North Pickering, however, could be used as pilot projects to test the feasibility of such systems to determine the desirability of such measures.

North Pickering will lend itself very well to more efficient and sophisticated methods of administration. Revised metering and billing procedures to make water use charges more directly a function of demand would be desirable.

The direct water reuse schemes such as that proposed by the Ontario Research Foundation may have application in North Pickering for an isolated, densely developed area which is difficult to service with conventional water mains. However, extensive recycling and reuse of domestic waste water, or a separate contaminated water distribution system using sewage effluent for lawn-watering and toilet flushing, on a wide scale for North Pickering is not considered economically feasible in the near future.

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STATE of the ART REPORTS

COMMUNICATIONS 6

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6.0 COMMUNICATIONS

6.1 INTRODUCTION

Modern telecommunication systems are both a result of and a major asset to the technological revolution of the twentieth century.

The first development, the telegraph, used a coded electrical signal transmitted through wires to communicate over distance. The progression has been through voice communication, to visual communication, to man to computer, or computer to computer communication. Each of these developments has required a progressively larger bandwidth or range of frequencies to transmit information. The amount of information that can be transmitted is proportional to the bandwidth. The capacity of telecommunication systems has been increasing exponentially at a rate of 10-fold every 17 years with no sign of a slowdown in the near future.

There are two basic systems for long range transmission of information:

a) Using cables or cable-like devices.

b) Using radio transmission or "wireless" systems.

Similar radio frequencies will interfere with each other, whereas they can be handled on separate cables to avoid interference. Thus, radio frequencies are a limited resource that must be allocated and rationed to the users.

As higher frequencies are developed, however, radio transmission capacity will not be as limited.

Consider, however, that the larger bandwidths are only keeping pace with the requirements of new uses for them. For instance, the telephone requires about a 4 kilohertz (4,000 cycles per second) bandwidth whereas colour TV requires 4,600 kilohertz.

Research and development in the field of telecommunications combined with computer technology will result in a profound

change in our society in the next two decades. Many key inventions have been made. It remains to realize the potential of their development. It is probable that the trend to increased mobility will be slowed or even reversed. Travel may be largely for pleasure with business being conducted via telecommunication systems.

6.2 CURRENT PRACTICE

6.2.1 Services Offered

The range of services offered on a wide scale to most of North America comprises direct dial telephone, teletype, low fidelity and high fidelity stereo sound broadcasting, colour TV broadcasting, facsimile (transmission and reproduction of documents), data transmission, mobile radio communications, aircraft, military and policeradio communications, and cable TV. Also included are traditional forms of communication offered by the newspaper and the postal service. The development of communication satellites has allowed for improved global telephone communications and has made possible world wide live TV broadcasts.

6.2.2 Systems Used

Various systems of cables, radio transmission and combinations of the two are presently used to provide the services available.

The basic cable systems are the telegraph network and the telephone network which are both large well-developed systems, and cable TV systems which comprise relatively small, sometimes unrelated, local networks.

The telephone systems provide every telephone customer (or sometimes several on a party line) with a wire pair connection to a central switching terminal. At the terminal calls are manually, mechanically or, more recently, electronically switched to make the connection with another customer. Calls within a switching area are returned along a wire pair. Calls outside the switching area are handled by trunk facilities. Coaxial trunk cables are often used and have the capacity for 15,000 to 20,000 simultaneous telephone conversations. To do this,

the broad frequency range of the cable must be subdivided into many unique channels. Each conversation is then adjusted in frequency to suit a channel and thus avoid interference. This process is called mutiplexing.

Wire pairs, carrier systems and microwaves are also used in the trunk system. Microwaves are relayed via ground stations or via satellites positioned in a stationary orbit.

Electronic switching in the telephone industry has made possible the push button or touchtone telephone. These units are more convenient to use and offer the potential of communicating with a computer.

Information can be sent in either analog or digital form. Analog transmission is the transmission of a continuously variable signal. Digital signals are, however, discrete or discontinuous signals. For digital transmission information must be coded into a sequence of discrete elements. This is the basis of computers and the preferred method of data transmission.

Teletype systems are widely used and comprise cables and microwave relay systems for data transmission. This service utilizes local telephone lines to connect customers to the teletype system.

Radio, TV and all mobile communication systems rely on the atmosphere for the transmission of radio waves. because of local interference, frequencies are allocated to users and a license is issued. Frequencies in common use range from 10^5 hertz to 10^{10} hertz. Submarines use frequencies as low as 10^4 hertz and frequencies up to 10^{12} hertz are being researched.

Radio waves are subject to interference by storms, aircraft, and obstructions. The shorter the waves (higher frequency) the more subject they are to interference.

TV viewers, remote from broadcast centres, were frustrated with poor reception until the development of cable TV or community antenna TV (CATV). A large antenna is located at the best vantage point to pick up locally weak signals. The signals are then amplified, rearranged in the frequency band, and distributed to subscribers through a coaxial cable. The signal must be re-amplified at intervals along the cable. The same cable also carries AM and FM radio signals. One cable can carry up to 30 or 40 TV channels. Direct communication via the cable is also possible and most cable operators provide local programming.

Most other communication services offered utilize one or a combination of the systems described above. Newspapers and mail delivery still rely on personal delivery of the message.

6.3 INNOVATIONS

6.3.1 New Technology

In the past decade there have been several inventions of enormous potential. The development of these inventions into operating systems will open the door to a wide range of new services.

These inventions include:

a) The Communications Satellite - Suddenly this has provided telephone and television links to the remote or underdeveloped world. Much larger satellites will be built and will have an enormous impact on education and communications throughout the world. The satellite antennae in some underdevloped countries stand next to fields ploughed by oxen.

b) The Helical Waveguide - A pipe that can carry 250,000 simultaneous telephone calls or equivalent information over long distances.

c) The laser - This means of transmission, still in the research laboratories, has the potential of carrying many millions of simultaneous telephone calls or their equivalent.

d) Large-Scale Integration (LSI) - A form of ultraminiaturized computer circuitry that probably marks the beginning of mass production of computers and computerlike logic circuitry. It offers the potential of extremely reliable, extremely small, and, in some of its forms, extremely fast computers. If large-enough quanities can be built, this circuitry can become very low in cost.

e) On-Line Real-Time Computers - Computers capable of responding to many distant terminals on telecommunication lines at a speed geared to human thinking. They have the potential of bringing the

capabilities and information of innumerable computers into every office and eventually every home.

f) Picturephone - A public dial-up video-telephone system in which subscribers see as well as hear each other.

g) Large TV Screens - TV screens that can occupy a whole wall if necessary.

h) Cable TV - Provides a cable into homes with a potential signal-carrying capacity more than one thousand times that of the telephone wires. It could be used for signals other than television.

i) Voice Answerback - Computers can now assemble human-voice words and speak them over the telephone. This, coupled with the touchtone telephone set, makes every such telephone a potential computer terminal.

j) Millimeter-Wave Radio - Radio at frequencies in the band above the microwave band can relay a quantity of information greater than all the other radio bands combined. Chains of closely spaced antennae will distribute these millimeter-wave signals.

k) Pulse Code Modulation - All signals, including voice, video-phone, music, facsimile, and television along with computer data can be converted into digital bit stream and transmitted, over the same digital links. Major advantages of efficiency and quality of transmission accrue from this.

l) Computerized Switching - Computerized telephone exchanges are coming into operation, and computer-like logic can be employed for switching and "concentrating" all types of signals.

m) Data Banks - Electronic storage for huge quantities of information that can be manipulated and indexed by computers and that can be accessed in a fraction of a second.

Because of the enormous capital invested in telephone cables and switching equipment and problems with manufacturing new equipment that will be compatible with existing equipment, the development and application of many of the inventions will be slow. Developments, however, have progressed on modifying the existing equipment for better use. Computerized switching has been integrated into the network and is compatible with existing mechanical switching.

Bell Telephone have developed their T1 system in which wire pairs are made to carry 24 voice channels each using pulse code modulation and time division multiplexing. The T2 carriers, soon available will take the signals from 4 T1 carriers or will handle 1 picturephone signal.

Cable TV coaxial cables have the potential for carrying much more information and providing many more services than at present. Cable TV channels could be subdivided into 100 stereo music channels or 600 voice channels. The cable can also be made to provide two-way communication via an answerback channel. It will not replace the telephone system because of the lack of switching equipment. However, some information about the TV cable user could be returned to a computer.

6.3.2 New Services

Using the recent developments in communication systems, many new services can readily be provided to new communities. Most existing systems can also be modified to provide the new services.

Using the touchtone telephone and a computer, many services can be offered. The computer can be equipped with a voice answerback program and the user simply converses with the computer. The user enters data via the 12 button touchtone phone and receives verbal instructions and answers from the computer. Other devices could also be added to either print out the information or display it on a video screen.

In the home this system could have many applications; as a computer terminal or a desk top calculator; for shopping; for hotel, airline and restaurant reservations; for banking and investment dealings and many other uses. For businesses and industry the uses are even broader.

To satisfy the increasing demand for rapid data transmission, companies might be established for that purpose alone. The Datran Company is presently being established in the U.S. The system could rely on microwave transmission for both trunk and local networks. They could provide switched transmission, fully digital, with low cost, high quality service.

Video-telephones will be available but will be limited for long distance use because of the very large frequency capacity required. One long distance picturephone call would displace 100 telephone calls.

The telephone network can also provide automatic remote reading of utility meter; it can provide surveillance of homes and businesses with alarm signalling of emergency conditions to a central point; it can provide remote control of various in-home devices (for instance one could phone home and command the oven to turn on or the lights to turn off).

Cable TV also has the capability to provide many new services to the community. Local programming will cover municipal government and community, cultural and sporting events. A wide range of educational courses will be economically provided to in-home students. Cable TV could replace newspaper and mail delivery by presenting the information via the TV screen. Printed copies could be made of those documents required for further reference.

With both the picturephone and cable TV, travel for business purposes will be greatly reduced. Video conference calls can replace meetings.

One will be able to select video and audio programs from libraries using the touchtone phone to request the program and the TV set to receive it.

Once these basic systems are provided many other commercial and personal services will develop.

6.3.3 Future Technology

The technology being developed now and to be developed. in the future will be directed towards satisfying the demands of the future. The demand will be for increased data transmission capacity (i.e. increased bandwidths) and for improved networks (local, national and worldwide).

Improved coaxial cables will carry over 80,000 voice calls. Helical waveguides will carry 250,000 voice calls. The development of lasers and their probable transmission through optical cables will allow for a several hundred-fold increase in capacity over waveguides. We may one day modulate gamma rays to carry information.

Microwave radio transmission will also develop and is most promising for many requirements. Microwaves will be relayed between earth antennae and satellites. It would be possible to broadcast directly from a satellite to a home antenna. Such systems will greatly reduce the cost of long distance communications and will result in cost virtually independent of distance.

The demand for mobile telephones is increasing rapidly and in most large cities the demand cannot be met because of a shortage of frequencies. New technology in frequency utilization and changes in frequency management could result in 100-fold increase in available channels.

Increased bandwidth and network capacity will allow development of high fidelity wall size TV and three dimensional TV by laser holography.

Data Banks with huge storage capacities will be possible and large corporations with many widespread centres of operation will rely on one central data bank, accessing it using digital networks built for that purpose.

Future technology will result in the "Wired City".

6.4 APPLICATION TO NORTH PICKERING

6.4.1 Initial Services

North Pickering could be provided with full touchtone telephone service using the traditional wire pair connection to a local electronic switching centre. Fifty pairs will probably be allocated for every 20 homes. This will allow for future video-phone service and also for many of the previously mentioned new services such as meter reading. Also provided will be a carrier system for TV and related services. It will be difficult to initially provide many unique new services to North

Pickering since they rely on networks and systems having a much larger base.

However, the new city should be planned to make the most use of the telephone system and its capability as a computer terminal. A central computer should be co-ordinated with the telephone switching centre and with the residential, commercial and industrial development.

Ample facilities for local TV programming should be planned, Communications of this nature can spur the development of community spirit and increase public awareness.

Telephone lines will also be used for telemetering purposes such as traffic control and surveillance of public utilities and mechanical equipment.

6.4.2 Provision for the Future

It is probable that the only necessary provision for future communications facilities will be the installation of spare ducts. As new technology develops and the bandwidth of cables increase the number and size of the cables and ducts to carry them may, in fact, decrease. Physical space will be required for future installation of amplifiers and manholes for new equipment. Switching centres and equipment buildings should be designed for future expansion.

6.5 OWNERSHIP, OPERATION & REGULATIONS

At present, the telephone systems in Southern Ontario are generally owned and operated by Bell Canada and are regulated by the Federal Government. There are also about 40 small independent and municipally operated telephone systems but these are regulated by the Ontario Telephone Service Commission. They rely to a great extent on the Bell system for outside calls.

The coaxial cable portion of Cable TV in some cases is installed by Bell and rented to federally licensed Cable TV operators who provide the antenna and head-end facilities and operate the service. In other cases, the Cable TV operator installs, owns and operates complete CATV systems.

Teletype services are provided by CN-CP Telecommunications and Bell Canada. They use the telephone system for local connection and microwave relay for long haul services. A crown corporation, Telesat, provides a satellite-microwave relay service to other systems.

Radio transmissions are provided by many individual companies, but all are licensed by the Federal Government to use a specific frequency.

The broad range of telecommunication services that are available presently or which will be offered in the future are provided by several different organizations and regulated by various Federal and Provincial authorities.

There is a perceived need to combine and co-ordinate these services into one telecommunications system. Possible advantages arising from such a proposal would include economy of capital expenditures and operation cost, improvement in the quality of service and a more rapid development in the provision of new and more advanced services.

The manner in which this could be best accomplished, is worthy of serious consideration. Alternatives that could be considered include ownership and operation of a complete telecommunications system for North Pickering, by publicly owned utility, or a Crown Corporation or perhaps, by some agreed combination of the foregoing and the existing telecommunication organizations.

Further evaluation will be required to compare these proposals with the traditional approach to arrive at the most desirable method for the provision of telecommunication systems to the North Pickering Community.

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STATE of the ART REPORTS

ELECTRICAL POWER SYSTEMS

7

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7.0 ELECTRICAL POWER SYSTEMS

7.1 INTRODUCTION

This report addresses itself premarily to the electrical power transmission and distribution systems proposed within the community. Reference is made to generation and end-use aspects only as they relate directly to the traditional transmission and distribution systems. The Conservation of Energy Report included references to electrical power and should be referred to for the conservation aspect of electrical power.

7.2 CURRENT PRACTICE

7.2.1 General

The current practice section covers present uses, system characteristics and administration of electricity transmission and distribution systems. With only a few exceptions the Ontario Hydro Electric Power Commission provides generation and high voltage transmission facilities to most of Ontario. Great Lakes Power Corporation is the primary exception in providing electricity to a large section of Northwestern Ontario.

7.2.2 Uses

Electricity is presently used almost exclusively for all lighting and communication type applications. Appliances of all types are predominantly powered directly by electricity, with natural gas being the only other common power source. Space heating with electrical resistive type units has become quite popular recently for new residential, commercial and institutional type buildings where the increased insulation requirements can be economically met.

Water heating with electricity is the most popular method with natural gas being the only other common method.

Except for densely populated urban areas where streetcars, trolley buses or subways are driven by electrical power, the transportation field does not at present directly utilize significant amounts of electricity.

7.2.3 Characteristics and Equipment

Transmission lines from generating plants to urban areas conduct electricity at voltages of 115 KV or greater via stranded aluminum-steel wire cables suspended on insulators from steel or wood towers. The high voltage transmission lines are usually constructed on utility controlled property or right-of-way, utilized for only the transmission line. In densely developed urban areas such as the central business district of large cities it is sometimes necessary to carry these high voltage lines underground. Underground high voltage transmission lines are oil insulated and quite inefficient due to reduced heat dissipation characteristics. Construction costs for underground high voltage lines are extremely high even when installed in conjunction with other services or utilities in utilidors.

To service urban areas, the voltage from the high voltage transmission network is reduced in transformer stations to 27.6, 34.5 or 44 KV. In Ontario, these transformer stations generally reduce the voltage to 44 KV. For urban areas, one of these transformer stations normally service a community of upwards of 100,000 people and is generally located outside the developed area of the community.

In the past, the sub-transmission lines from these transformer stations have normally been carried by over-head stranded aluminum cables mounted on poles constructed on public rights-of-way, usually streets.

For the 44 KV sub-transmission lines, distribution stations are utilized to reduce the voltage to 15 KV. These stations are internal to the community, constructed on an area approximately 200 feet by 200 feet, and normally service a population equivalent of about 10,000 to 15,000 people. If the transformer stations on the high voltage transmission lines are 27.6 or 34.5 KV, these distribution transformer stations can be eliminated.

From the distribution stations, primary distribution transmission lines carry electricity throughout the community at 8,320, 13,800 and 15,000 volts. Recent practice in urban areas in Ontario generally throughout North America is for primary distribution lines to be constructed underground in new residential and commercial development and in some instances in areas of new light industrial development. Programs are

underway in many existing communities to convert existing overhead primary distribution lines to underground lines. The primary distribution lines are generally constructed on public rights-of-way, usually streets. Some municipalities have constructed lines for single family residential areas in easements along the rear lot lines. Local distribution transformers reduce the voltage from the primary distribution lines to the voltage required by the consumer, usually 110, 220 or 550 volts. For residential areas one distribution transformer is required for every 7 to 10 houses depending upon electrical demand. These local transformers in overhead distribution systems are generally located on poles. For underground systems in residential areas, the local transformers have generally been pad mounted in either the front or rear yards, depending upon the location of the primary distribution lines. For commercial or industrial areas, the transformers have often been located within the buildings.

Alternate transformer types used for residential areas to improve the aesthetics of standard pad-mounted units are low profile pad-mounted, submersible types for underground vault mounting, direct burial units, and mounting in street light poles (Pole-Tran).

For underground construction of primary distribution and subtransmission lines, direct burial of copper or aluminum stranded cable encased in solid polyethylene insulation has generally been acceptem in North America. For protection of the buried cable in areas where it could become damaged, such as under roads, the cable is generally encased in steel pipe conduit or concrete.

7.2.4 Administration

In the past, Ontario Hydro has established its own rates and has reviewed the rates of the local utilities to whom electricity is sold. For municipalities with over 200,000 population, Ontario Hydro cannot control local utility rate changes. In the future, the Provincial Government will approve all rate changes proposed by the Ontario Hydro Electric Power Commission. For rural areas where no municipal utility company exists to accept responsibility for electrical distribution, Ontario Hydro constructs, maintains, operates, and administers the system. Otherwise, electricity is wholesaled to the local utility company which constructs, maintains, operates and administers the local system with guidance where required given by Ontario Hydro.

The Canadian Electrical Code establishes minimum safety standards for electrical work within buildings. For other installations, Ontario Hydro and the individual utility companies abide by standards set by their own organizations. Ontario Hydro representatives inspect all new installations prior to approval for connection, and they also approve certain electrical construction materials and appliances from a safety viewpoint.

Individual metering of electricity is presently practised for all single family residences, most duplexes, townhouses, and small apartment buildings. Larger apartments, commercial and institutional buildings usually do not meter individual tenants. In such cases, a unit rate based on floor area or other similar parameter is used by the owner to bill the individual tenants.

Meters for residential consumers are generally read manually by utility company representatives from once to approximately six times per year with interim billings based on projected usage from past records. In voices have been issued generally every 2 or 3 months, although the trend is to decrease this time period. Large users of electricity have meter readings on a more frequent basis and are generally billed monthly.

Charges for electrical power for residential and small commercial users are based on an inverse pricing structure. For example, the charges for the first 50 KW hours per month are at a higher rate than the next 150 KW hours per month and the remainder at an even lower rate. Large users also are invoiced on the basis of lower unit preice for increased use but in addition they are assessed a cost based on the peak rate used for a short period of time during the month.

7.3 INNOVATIONS

7.3.1 General

Innovations to electrical power transmission and distribution systems generally involve improvements in equipment and materials and the location of the facilities, rather than the uses, methods or processes. Innovative developments in methods and processes are primarily in the generation and end-use fields where increased emphasis on conservation of energy and pollution control have been prime factors. Where innovative generation or end-use systems could directly affect the internal servicing of a community, references are made. Otherwise, such aspects are considered to be beyond the scope of this report.

7.3.2 Characteristics and Equipment

Transmission technology for the near future does not envision great changes in present practice. Direct current transmission is feasible and more efficient than alternating current transmission over long distances where there are relatively few take off points. However, when several take-off points are required

over short distances the cost of rectifiers is prohibitive.

Supercooled transmission lines (30^0 absolute) and cryogenic transmission (10^0Absolute) are feasible in the foreseeable future for very high voltage transmission at 500 KVA or greater. The refrigeration plant, circulation system and insulation requirements which permit use of smaller cable for higher voltages cannot be justified for lower voltage systems.

The high cost of copper has led to increased use of aluminum for conductors at lower voltages. In addition, aluminum cables could be used for building wiring at considerable savings in material cost over the traditional copper. It has not become an accepted practice since the technology of working with aluminum is much different than copper. Experiments with other conducting materials, primarily sodium, show promise but have not been developed to the degree that they have been accepted by the utility authorities, again primarily because of the different technology involved in working with the conductor. For sodium, the jacket must support the conductor, and corkscrew rather than terminal connections must be made.

Changing transformer and switchgear technology is resulting in ever-increasing compactness of units. Vacuum switchgear innovations have been proven feasible and will result in considerable space saving benefits in the future. Direct buriel distribution transformers are presently being used in a few municipalities and with improved manufacturing techniques their use may increase. Distribution transformers located in street light poles are available on the market. The limited transformer capacity, oversize light pole and difficulty in coordinating street lighting and transformer requirements are some of the reasons that these units have not come into broader use.

Internal source heat pumps installed for use in new, large, commercial or institutional buildings are becoming well established for certain space heating and cooling applications in Ontario. As well as being more economic to install in new buildings designed for their use than traditional heating and cooling systems, the internal source heat pump is also more energy efficient.

Studies by Ontario Hydro and others indicate that the potential for use of heat pumps in residential units is very encouraging. In cases where both heating and air conditioning are to be provided, the capital cost of heat pump installations compares favourably with traditional methods. Although water and earth heat sources have been evaluated, it appears that the air source unit has the most potential . The minor problems which have plagued existing installations including high installation costs, unacceptable noise levels, leaks, and lack of experienced installation and service men are being overcome.

7.3.3 Location

For aesthetic and maintenance reasons, electrical power transmission systems are being located underground in most new residential developments. The increased cost of underground construction rises quite rapidly with increased voltages. At low voltages, the installation cost is about twice the cost for overhead whereas at high transmission line voltages, the cost of underground is presently about twenty-five the cost of overhead. With advances in materials and methods of transmission, the cost ratio should decrease substantially and underground transmission will become more feasible at higher voltages.

Although back yard location of electrical distribution lines was popular a few years ago for residential areas, the trend is generally back to the road allowance location. As an alternate to front yard pad-mount, direct burial, pole or underground vault location of distribution transformers, such transformers may in future be located adjacent to the building foundation, the housing possibly built integral with the foundation. Such is presently done in condominium townhousing developments, apartment and commercial buildings. One such transformer could service the houses on either side. An individual transformer for each residential unit is not considered economically feasible.

Common trench construction of underground electrical lines with other utilities is possible and in use to an extent. However, it is probably feasible only with other shallow depth utilities such as communications systems, gas lines, and oil lines.

7.3.4 Administration

Consumers are demanding more frequent billing of electrical costs based on actual reading of the meter. Since manual reading usually requires access into the building it may take the reader several tries to get a reading. Complaints arise from adjacent owners of similar properties receiving different bills representing different length time periods which result from meter reading delays. Automatic remote meter reading would eliminate many such complaints. Recent experiments and test installations have proven the technical and economic feasibility of automatic meter reading of electrical power meters for single family residential areas.

As the cost of energy increases, the inverse pricing structure is levelling out and will likely continue to do so. The practice of higher costs for short term high peak demand. will also likely continue with large users being encouraged to use off-peak power. Advancements in peak shaving techniques will make such practices more common for large users and may also be applied to domestic users on an area or municipality basis.

7.4 APPLICATION TO NORTH PICKERING

7.4.1 General

North Pickering will be tied into the provincial 230 KV electrical power transmission network. A transformer station south of the community adjacent to the existing 230 KV line near Cherrywood will reduce the voltage for community use. Depending upon the distribution voltage for community use. Depending upon the distribution voltage used for North Pickering and the load demand in the Region, a second transformer station to the north or east of the site may be required. Thus, there will bee little opportunity to utilize innovative high voltage transmission systems or materials within North Pickering Innovative systems or characteristics for the distribution of electrical power do not appear to have significant advantages and have not been sufficiently developed to be considered for North Pickering.

Eliminating the need for distribution stations within the community by utilizing lower voltage transformer stations and sub-transmission lines may be warranted and should receive further consideration. According to Ontario Hydro officials, it would not be practical to service only North Pickering with the lower voltage system without also adopting such a system for an adjacent region.

Based on conservation of energy principles, heat pumps should be seriously considered for installation in residential as well as commercial and institutional buildings to replace electrical resistant space heating where air conditioning is also to be installed.

The security of electrical service is an important consideration in the planning of the electrical transmission and distribution network. Early determination of levels of security for various areas of the community will permit proper planning and result in significant economy in electrical power provision.

Other than these possible changes in present practice, it would appear that the application of innovative methods for servicing North Pickering with electrical power will be primarily in the location and administration areas.

7.4.2 Specific Applications

Underground primary and secondary distribution of power should be considered as a necessity for all residential, commercial and recreational areas within North Pickering. Serious consideration should be given to underground location of primary and secondary distribution in industrial areas and for underground location of sub-transmission lines in residential areas. If a second transformer station is required and it is necessary that the high voltage transmission lines to it pass through the project, consideration should be given to placing these underground, at least in residential, commercial, or recreational areas.

From work done by Ontario Hydro, it would appear that the mini-pad or light pole-mounted transformers would be the best compromise for residential transformers in North Pickering. The small size of the pole-mounted units and their incompatibility with street lighting may however limit their use. Consideration should be given to locating the transformer immediately adjacent to the house as part of the foundation for multiple family units.

Automatic, remote meter reading of electrical as well as other meters for residential areas of North Pickering is recommended. Investigations into a multi-utility system for automatic meter reading of several services warrants further investigation. This aspect is covered in more detail in the Systems Administration and Communication Reports.

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GAS and OIL ENERGY SYSTEMS

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8.0 GAS & OIL ENERGY SYSTEMS

8.1 INTRODUCTION

This report addresses itself primarily to gas and oil transmission and distribution systems within the community. Reference is made to production and end-use aspects only as they could relate directly to traditional transmission and distribution systems. The Conservation of Energy Report includes references to oil and gas systems and should be referred to for the conservation aspect of gas and oil consumption. The Current Practice and Innovations sections cover uses, system characteristics and administration. A brief comment is also made on possible applications to North Pickering.

8.2 CURRENT PRACTICE

8.2.1 Uses

Natural gas is used extensively for space heating, water heating, and cooking appliances in areas which are serviced by natural gas distribution systems. In such areas, natural gas is also used to a lesser degree for other appliances, including refrigeration, clothes drying, air conditioning and for a few lighting applications. A large number of industrial processes utilize natural gas as an energy source.

Motor gasoline including aviation fuel, fuel oil and stove oil are the primary types of petroleum products used as energy sources. All are generally distributed to the consumer in bulk. Gasolines are used primarily to power various types of transportation vehicles. Lighter grade fuel oils such as diesel oil are also used extensively as an energy source for transportation vehicles and construction equipment. Fuel oil is the most common energy source for space heating, presently commanding over one-half of the home heating market in Ontario. Water heaters are the only other significant use for fuel oil in the home. Industry utilizes fuel oil extensively as an energy source for space heating and process machinery.

8.2.2 Characteristics and Equipment

a) Natural Gas - Natural gas is carried from the production field to major urban areas in transmission lines at pressures generally in the range of 500 to 1000 p.s.i. Storage facilities are strategically located along the transmission line in order to meet peak demands. Regulator and metering

stations are located at take-off-points along the transmission line to reduce the pressure to approximately 350 p.s.i. and to meter the volume for sale to the local or regional utility companies. The local or regional utility companies carry the gas from the main transmission line to their communities at this pressure. A few major users may receive natural gas at 350 p.s.i. (transmission pressure) but generally, it is reduced to 175 p.s.i. (high pressure) at regulator stations within or adjacent to the community to be serviced. Gas rated at 175 p.s.i. is delivered to medium size customers including industrial, institutional and large commercial consumers. Normally, residential areas are not serviced directly from the 175 p.s.i. (high pressure) system but from a reduced intermediate pressure system rated at 60 p.s.i. Services to consumers are made off the intermediate pressure system where a regulator ahead of the individual meter reduces the pressure to approximately 5 inches water column for use within the residence.

Normally all regulator stations on the 175 p.s.i. (high pressure) system and lower pressure systems are located underground in boxes generally constructed from concrete. The standard location for underground gas mains in the Metropolitan Toronto area is 3 feet off the streetline in the road right-of-way.

Steel pipe with welded joints has been used extensively for gas mains. Prior to the use of steel pipe, cast iron pipe with cemented or leaded bell and spigot joints was used. The joints of such pipe cannot withstand the higher pressures of the steel pipe with welded joints and its use has been generally discontinued. In older sections of cities which have been serviced with gas for many years, cast iron pipe is still in use but the pressures are reduced to a few inches water column in such areas (low pressure systems). Steel pipe is generally coated with bitumen and paper wrapping and provided with cathodic protection systems for corrosion control. Smaller diameter pipes are coated with a plastic coating which replaces the bitumen and paper. For smaller diameter medium pressure mains (less than 6-inch diameter) polyethylene pipe has recently been used to replace the steel pipe. Polyethylene pipe has almost universally replaced copper for medium pressure service connections.

b) Petroleum Products - Oil and the other refined products are carried from the refinery to the community in many ways including pipeline, ship, rail and truck. At the community the products are deposited in central storage terminals.

This paper concerns itself primarily with pipeline transmission and distribution to and from the terminals and to a limited degree with local truck distribution from central storage terminals.

Refined products transmission pipelines from the refinery to the community can carry many types of petroleum products sequentially in the same pipeline. Products carried normally are aviation fuel, motor gasoline, and middle distillates such as fuel oil and stove oil. For normal community demands, gasoline, fuel oil and diesel oil are the major products. Aviation fuel is an important product for communities adjacent to a major airport.

Transmission pressures normally are in the range of 1000 to 1400 p.s.i. Take-offs are provided along the transmission main to provide petroleum products to the local or regional suppliers. Pressure regulating and metering stations to reduce pressure generally to less than 300 p.s.i. and measure the quantity of product supplied are provided at each of these take-off points. Such stations are above ground structures generally occupying less than 2 or 3 acres.

The company which receives petroleum products from the transmission line or other transport media generally provide terminal storage for the various products it intends to distribute to consumers. The size of these terminal storage tank yards depends upon the size of the market to be serviced. Often, there is only one take-off point. The area occupied by the storage tanks is many times the area required for the regulator and metering station. Terminal storage yards to service larger cities may occupy up to a hundred acres or more if the facilities of all distribution companies were combined.

Oil pipelines are generally constructed using steel pipe with welded joints. Corrosion protection systems similar to gas pipelines are usually employed.

Generally, oil is distributed to the consumer from the terminal storage yards by tank truck. In some cases, rail may be used for large consumers or as an intermediate step between regional storage and local storage. Consumers receiving oil by tank truck or rail generally must have their own storage facilities. The cost of the product to the consumer is somewhat dependent upon the quantity of product he can accept at one time. In a few cases, a piped distribution system is provided by the distribution company to provide fuel oil to a number of consumers in a concentrated area. Metropolitan Toronto as well as a few other Canadian centres have several residential subdivisions serviced by such piped systems.

8.2.3 Administration

Materials, equipment and appliances used by the gas and oil industry must be approved by the Canadian Standards Association. For natural gas distribution the provincial government awards franchises for certain areas to a specific gas utility company. The Gas Utilization Code specifies materials and workmanship inside the building from the outlet of the individual consumer meter. The Pipeline Distribution Code specifies materials and workmanship for all facilities upstream of the individual consumer's meter.

Each individual consumer is metered and the rate at which the consumer is charged varies with the quantity of gas used and the class of service provided. An inverse pricing structure, based on the number of gas appliances installed, is used to arrive at the rate for residential or commercial users.

For industrial users the inverse rate with quantity used is modified according to the degree of interruption of service that can be tolerated.

For petroleum products the various oil companies decide on the method that their product can best be transported from the oil fields to the refinery and the refinery to the distributors and the distributors to the consumer. Often several oil companies co-operate in utilizing common methods of transporting bulk petroleum products. Many of the oil transmission pipeline companies are controlled by a consortium of oil companies. Until recently there was no government control on the rates that the various oil companies could charge local distributors or the local distributors could charge consumers. Competition between the various firms was an effective means of controlling the price. Recently due to shortages arising from supply and distribution inadequacies, the government has stepped in to place ceilings on the rapidly rising prices of petroleum products on the wholesale level.

The National Energy Board specifies standards, controls and inspects interprovincial gas and oil pipelines whereas the Ontario Energy Board assumes similar responsibility for pipelines entirely within Ontario.

8.3 INNOVATIONS

8.3.1 General

Innovations in the gas and oil energy system field are primarily in the materials and equipment field rather than in new uses or methods of supply and distribution. Some of the innovative equipment results in changing the form of the product which can result in innovative uses for that particular product. In general, it is believed that most of the innovations in the gas and oil energy field will not significantly alter the traditional methods of providing internal services to a community. Conservation of energy considerations may result in more energy efficient delivery systems such as pipelines being used in place of vehicular modes of transport.

8.3.2 Uses

The development or reformed natural gas (RNG), which is significantly more reactive than natural gas, will result in new uses as well as improved existing uses. The catalytic combustion process can be used with RNG which eliminates the need for a pilot light or electronic ignition system. Within ranges a completely uniform temperature distribution with an infinite turndown ratio can be achieved. RNG also offers the opportunity for a new type of gas light using the candoluminescence process. Natural gas is also converted to RNG to power fuel cells. Fuel cells are an innovative process for generating electricity in a method somewhere analogous to the lead cell battery only powered by gas not lead plates. Since they are only about 40% efficient in conversion of natural gas to electricity, their potential does not lie in large scale generation of electricity but rather in providing electrical service in conjunction with direct use of natural gas for such uses as space heating, in order not to be dependent on exterior supply of electricity.

Natural gas fueled vehicles utilizing liquid natural gas (LNG) or compressed natural gas (CNG) are actively under development. The Munter Environmental Control System (MEC unit) can cool, heat, control humidity and provide air filtration, ventilation and air motion in one package unit. The air is normally heated by a gas burner but is also adaptable to heating by solar radiation.

Instant water heating, as presently practised in Europe, utilizing natural gas may become more popular due to its increased energy efficiency over heating large volumes of water in storage tanks.

Innovative uses of petroleum products for energy are somewhat limited. Innovative consumer products, similar to artificial fire place logs, will no doubt be developed. However, the only major potential change in traditional uses of oil as an energy source appear to be as a result of the development of the blue flame burner. This burner, which is about 5 years away from consumer use, as well as being more energy efficient than the conventional yellow flame burner, is also much cleaner and may open up new uses for fuel oil in the household appliance field.

8.3.3 Characteristics and Equipment

a) Natural Gas - Little change is envisioned in the traditional methods of transporting and distributing natural gas. The low and medium pressure systems are presently being phased out for intermediate (60 p.s.i.) or higher pressure systems and this program will continue until all the low pressure systems are replaced. The conversion of natural gas to the liquified state (LNG) for long distance transmission purposes appears to be feasible and may also be applicable in a few isolated cases for local distribution but it is not seen to be feasible in the near future as a means of distributing natural gas to consumers under normal circumstances.

Similarly, there may be a few instances where reformed natural gas would in the future be distributed to the consumers from a central conversion plant but this is not seen by gas company officals as being very probable.

As costs of traditional materials and construction methods increase, the use of new materials, more compact equipment and innovative construction practices will continue in this field as well as others. Polyethylene pipe may continue to replace steel pipe in even the larger diameter gas mains and more sophisticated corrosion control practices will be employed.

Peak shaving techniques to permit more constant load requirements such as reduced rates to interruptible customers and increased costs for peak demands are likely to be practised in the future.

Innovative equipment such as the fuel cell and the Munter's Unit were mentioned under innovative uses. Coal gasification by such methods as the Lurgi Process have proven feasibility for large scale installations in Europe. With increased cost of, and decreasing quantities of natural gas, coal

gasification processes appear to be a major future source of energy in the form of synthetic natural gas (SNG).

Spark ignition advancements now appear to justify future replacement of the standard pilots in many natural gas burners. Catalytic ignition with RNG is further in the future.

b) Petroleum Products - Similarly to natural gas transmission and distribution systems, little change is envisioned in the methods and practices of petroleum product transmission and distribution, except for improvements in materials, equipment and construction techniques. Oil transmission pipelines can potentially carry a much wider range of products than they have in the past. Liquified petroleum gas (LPG), naptha, rubber solvents and, coal in slurry with crude oil or water have all been proven feasible in various systems. The range of potential products is much greater especially if carried in encapsulated form.

Local distribution of heating fuel in piped systems to individual consumers, although more energy efficient than than truck delivery, is not seen by all oil distribution companies as being the way of the future. The reason for this may be based on desire to maintain free and open marketing conditions to all consumers rather than system economics or energy conservation.

8.4 APPLICATION TO NORTH PICKERING

8.4.1 General

The existence of the Trans Northern Pipeline Company's refined oil products pipeline through the North Pickering Community and the TransCanada PipeLines Company's natural gas pipeline a few miles north of the community provide the opportunity for economic and energy efficient delivery of gas and oil energy sources to the community. The existence of these two transmission systems suggest there will be little opportunity for the community itself to utilize innovative methods of transporting gas or oil energy sources to the community unless it is done by, or in co-operation with, one of the operating companies.

Recently it has been indicated that Interprovincial Pipelines Company are proposing to build a new 30-inch diameter oil pipeline across the project site. The route of this pipeline is presently under study and has not yet been finalized. The

implications of this pipeline on North Pickering will be reviewed at a later date when more specific information is available.

Except for innovations in materials, equipment and utility locations, it appears that natural gas would be distributed throughout the community in the current and more recent traditional methods.

Although the oil distribution companies do not all agree that piped distribution of heating oil is desirable for the future, it is recommended that such systems be considered as an alternate to truck delivery, especially in some of the more densely developed areas, should oil be a substantial part of the building heating market in the area.

8.4.2 Specific Applications

With the abundant and economic supply of electricity available in the area, it is doubtful if the adoption of the fuel cell for electricity generation even on a limited scale or the other innovative uses of reformed natural gas such as lighting will be applicable to North Pickering. In cases where air conditioning is to be used in buildings the Munter's Environmental Control System appears to hold significant promise as do the air source heat pumps, both being competitive economically and much more energy efficient than separate conventional air conditioning and space heating methods.

The blue flame burner for fuel oil apparently will not be developed soon enough to be applicable initially to North Pickering.

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CONSERVATION of ENERGY

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9.0 CONSERVATION OF ENERGY

9.1 INTRODUCTION

Until recently, with stable and relatively low cost of energy, little consideration was being given to conservation of energy in the planning and design of utilities, services and communications systems. Energy requirements were generally perceived as only one of the many items contributing to operating and maintenance costs which in turn were evaluated against capital costs of various alternate systems to determine the most economic overall system.

The recent energy crisis, however, and the realization that energy is a limited resource, have caused planners to more closely consider energy requirements, both as to type and quantity used, in evaluating technical and economic feasibility of particular systems.

9.2 CURRENT PRACTICE

9.2.1 General

The utilities, services and communications co-ordination area concerns itself primarily with the efficiency of transmission and distribution and less with end use, except as related to utility operation. Consideration of production is limited to the possible requirements for transmission and distribution of energy from non-traditional production systems or possible energy production systems which could be developed within a community to service only that community.

In order to evaluate energy utilization efficiency, however, it is necessary to examine at least to a limited degree the overall efficiency including production, transmission and end use aspects.

9.2.2 Energy Transmission and Distribution Systems

Energy is presently distributed to the consumer in a variety of forms from the raw product to a highly refined form which can be used directly. Forms include coal, steam, hot water, hot air, natural gas, propane, oil and electricity.

Pipelines and road, rail or water vehicular carriers are used to transport coal, steam, hot water, natural gas, propane and oil. Transmission cables are used to transport electricity. Road, rail or water vehicular carriers will not be evaluated since they are generally beyond the scope of this study.

The energy required for pipeline transport is made up of three factors; the energy required to raise the product from the generation pressure to the pressure required for efficient transmission; the energy losses in the transmission systems due to friction or leakage; and the energy required to convert to the pressure requirements of the consumer.

For piped gas transmission and distribution systems, approximately 4% of the gas collected in the field is required as energy to transport and distribute the product in compressor and pumping operations.

Steam and hot water piped transmission and distribution systems are generally quite inefficient due to heat losses throughout the system. Such losses limit the area which can be serviced by a steam or hot water system. Since most steam or hot water systems are utilized in conjunction with district heating and cooling systems, further reference will be made in that section.

Electricity is transmitted from the generating station to the consumer via a system of conductors either strung on poles or, for the lower voltages, buried underground. The voltages are stepped down throughout the system by transformer stations. Up to 14 per cent of the electrical power is lost during transmission and distribution from the generating plant to the consumer.

9.2.3 District Heating and Colling

The primary objectives of district heating and cooling systems have not in the past been the conservation of energy but rather the control of air pollution, centralized operation, and capital and operating cost advantages. However, the option of using solid waste as a supplementary fuel and the increased efficiency in energy delivery by district heating systems over vehicular means could result in substantial energy conservation for certain developments.

District heating systems utilizing steam or hot water are used extensively in Europe, particularly for areas of concentrated commercial, industrial, institutional, or residential development. Recently, it has also been used for low population density areas in Northern Europe and the United Kingdom. In North America, the public systems have been used in downtown or concentrated industrial areas. The Winnipeg system has been in operation since 1924 and the Toronto system which is the largest in Canada with over 70 large customers, has been operating since 1964. Other systems generally servicing downtown development in cities in Canada are located in Vancouver , London, Ajax, and Quebec City.

By combining electricity generation with district heating, using the bleed steam from electrical turbines during off-peak periods for district heating purposes, the cost of the heat produced is greatly reduced over a heat-only plant.

In Europe, solid waste incineration plants have been developed which supply steam or hot water to district heating systems. Montreal has recently constructed such an incinerator. One pound of garbage with about one-half the fuel value of wood can generate between 4 and 5 pounds of steam.Thus, significant conservation of traditional fuels can be realized by utilizing garbage for fuel. Since garbage must be disposed of year round, if may be preferable to combine electrical generating plants with district heating plants when using solid waste as a fuel.

In order to determine the feasibility of a district heating system when combined with electrical power generation and/or garbage incineration, it is necessary to evaluate the system as a whole, that is the heating, power, and solid waste disposal aspects, not just a single area.

9.2.4. Water and Sewage Services

Although conservation of energy has not been the prime reason, the majority of sewage collection and water distribution systems have been constructed in a manner which has minimized their use of energy. Sewage systems have been designed and constructed to operate wherever feasible on the principle of gravity with pumping used only where absolutely necessary to overcome difficult construction conditions. Capital cost premiums have often been paid to maintain gravity conditions rather than resort to pumping. Similarly, elevated water storage reservoirs which can be filled during off-peak periods by pumping are constructed so that gravity distribution can be provided during peak demand periods rather than pumping at these peak periods. Such practices have been employed for reasons of ease of maintenance and operation, lower capital and operating costs, as well as conservation of energy.

Due recently to the rapid rise in construction and material costs, the tendency has been to evaluate more closely some of the higher energy use systems in an effort to reduce capital costs. The pressure and vacuum sewer are examples of lower capital cost sewage collection system which will likely have greater energy requirements. Similarly, the use of direct pumping to meet peak water demands rather than constructing large elevated storage tanks, results in capital cost savings but increases peak period energy demands.

It has been reported that one-third of the electrical power generated in the United States in 1970 was used to supply water to municipalities and industry. Since pumping is the principle consumer, plans to reduce the quantities of water used can be effective in easing energy requirements.

9.2.5 Administration and Control

At present the responsibility for conservation of energy in the utilities, services and communications field lies mainly with the individual owners and operators of the various systems. The Provincial Government has some influence on the electrical transmission and distribution by the individual electrical utilities companies through the government-controlled Ontario Hydro Electric Power Commission. The Provincial Government also has a degree of control at the approval stage for water and sewage services, although in most cases the individual municipality in which the services are located operate the facility. Recently, the Ontario Government has formed a Ministry of Energy. This Ministry is responsible for establishing and administering an energy policy for Ontario.

The private or publicly-owned gas companies or oil companies are responsible for the construction and operation of gas and petroleum product transmission and distribution systems. Provincial and Federal Government controls consist of establishing standards of construction and operation primarily for safety reasons and inspecting the work to ensure that standards are met.

In the past, none of these agencies has seriously attempted to encourage conservation of energy except possibly related to the operating cost of their own facilities. Until recently, most have in fact encouraged increased use of their particular type of energy over the use of the alternate forms.

Unlike water supply and distribution where various government subsidies either direct or indirect, tend to depress the cost below the actual market value, energy costs before taxes generally closely reflect the cost of production and distribution. Transportation subsidies for raw fuel products such as coal and petroleum products and various forms of tax relief do affect the actual market value and they sould be considered when determining the economic feasibility of using solid waste as a fuel supply. In the past, price controls have generally been imposed to keep the price down, rather than allow it to reach the market value. This practice tends to discourage conservation of energy and in fact could subsidize the waste of energy.

At present, energy is often sold at bulk rates to building owners who in turn charge all tenants the same price no matter what the individual consumption. Separate meters for all tenants would tend to encourage individual conservation of energy.

9.2.6 Pricing Policy

The relatively low cost of energy encourages consumption. A typical family spends about 5 per cent of its annual budget on on energy sources including electricity, gas and gasoline

(includes transportation). The cost of fuel and electricity to manufacturers is about 1.5 per cent of the value of their products. Thus, efficient use of energy has not been of great importance in the economy. Historically, fuel prices have declined relative to other prices.

In the past, an inverse pricing structure has existed for all forms of energy; that is, more is paid for the first unit used than is paid for the last unit used, in any specific period. Such a pricing policy does not encourage conservation of energy.

9.3 INNOVATIONS

9.3.1 General

Innovative means of conserving energy in the utilities, services and communications fields are somewhat limited when compared to the fields of transportation, building design, legislation, or public education.

The use of energy efficient energy transmission and distribution systems, energy efficient sewage collection and water supply systems and the use of the energy potential from waste products are a few of the areas where innovative technology could result in substantial conservation of energy.

The greatest potential for energy conservation, however, could be in the selection of the optimum energy system for a particular need. Although specific examples of this potential saving are referred to in this report, the study of this aspect of energy conservation is far beyond the terms of reference of the study.

9.3.2 Energy Transmission and Distribution Systems

Technology holds little promise in significantly increasing the efficiency of the presently used piped or cable conductor energy transmission and distribution systems within municipalities. There is more potential in utilizing piped or cable facilities for an increased percentage of energy products rather than the relatively inefficient vehicular transport systems presently in use. Continued research into super-conducting cables and direct current transmission methods of electricity transmission in an effort to reduce the estimated 14% electrical energy transmission and distribution loss appears to be warranted. Such innovations are presently feasible for high voltage transmission but not for distribution voltages.

Each time energy is converted from one form to another, losses are incurred. It is more efficient then, to use the energy in as raw a state as possible to achieve the desired result. Burning natural gas or partially refined oil directly to achieve heat is much more efficient than burning it to create steam which drives turbines to produce electricity to be used for heat. Thus, the use of gas or oil for space heating, water heating, clothes drying, cooking, etc. is more energy efficient than using gas or oil to produce electricity which in turn is used for these heating purposes.

Further, in areas where gas or oil is used as fuel to generate electricity it would be more energy efficient to burn the gas or oil directly for space heating than use electrical resistance type space heating.

Improved insulation materials for steam and hot water pipelines can significantly increase the efficiency and area of service of such systems.

Lining of gas and oil pipelines with corrosion and abrasion resistant compounds, although not economically feasible in itself, would decrease the friction loss of such pipelines and would also simplify the possible utilization of such lines in the future for other purposes such as water distribution, waste collection and goods movement.

9.3.3 Innovative Energy Saving Systems

Although it is beyond the scope of this report to discuss all of the innovative means of conserving energy in the production or end use stages, a few of the promising methods which could be applied within North Pickering are described.

The adoption of electric heat pumps rather than electric resistance heating could equalize the space heating advantage of oil or gas fired heating systems and result in up to 45% savings in electrical energy when compared to electrical resistance heating. When installed in conjunction with air conditioning equipment, the capital cost compares favourably with conventional heating and air conditioning systems. Heat pumps, however, while they have been on the market for many years, tend to require more maintenance than conventional heating system.

On-site generation of electricity for commercial, industrial or concentrated urban areas by burning of solid waste, coal or via a fuel cell and incorporating the use of waste heat for space and hot water heating and air cooling would increase overall energy efficiency.

The use of solar energy for residential space heating and water heating is technologically feasible and may in the future be economically desirable.

Recycle of energy intensive materials such as aluminum, steel and paper would save energy as would decreasing production for such extraneous items as excess packaging.

With the present and foreseeable technology, decreasing the amount of waste heat rejected from existing steam-powered electrical generating plants seems minimal. The relatively low temperature of the coolant water and the relatively long distance between power plants and potential users are serious deterrents to the utilization of waste heat. Suggested potential uses of such low temperature waste heat are for irrigation or aquaculture, provision of ice-free shipping lanes, or for local space heating. New plants, such as the one presently operating in Berlin, can however, be specifically designed for both power production and space heating. The power capacity of such plants is sacrificed in order to raise the temperature of the coolant water sufficiently to satisfy space heating requirements.

A promising alternate method to the boiler-steam driven turbine system producing electricity from solid waste is the pyrolysis process. This process is under active development in the United States with many variations being studied by various firms and agencies. Basically, the process produces solid, liquid or gaseous fuels of low to medium grade BTU by single or multi-stage heating of solid wastes at temperatures from approximately 1000 to 2000^{o}F . The system lends itself to reclamation of inert materials, produces a significant quantity of readily useable fuel and greatly reduces the volume of solid waste. Further research is required before its applicability to North Pickering can be evaluated.

The replacement of incandescent lamps with fluorescent lamps will result in substantial energy savings for lighting. Mercury lamps and high pressure sodium lamps are even more energy efficient utilizing only 1/10 the wattage of incandescent lamps. In general, the more compact the development, the more energy efficient is the provision and operation of services, utilities and communications systems.

9.3.4 Implementation

Energy prices, public education, and government policies all can directly or indirectly influence the efficiency of energy use.

As discussed, the price for energy has in the past been relatively low and only very recently has it increased with respect to other prices. With increased prices for energy, it is likely that the present inverse rate structure for energy will be deemphasized. The effect that increased prices will have on demand is difficult to assess at this time.

Public education by utility companies to permit consumers to understand energy relationships and the importance and cost advantages of utilizing energy efficient appliances could slow the energy demand. Appliances could be labelled and advertisements could be required to state the energy efficiency.

Governments can influence energy consumption through encouraging recycling, regulation of rates, advertising restrictions, minimum efficiency standards for appliances and buildings, allocation of the most efficient energy system for specific needs, and research into energy conservation as well as supply technology.

Wider range of choices among alternatives should be considered in view of total cost. In some cases, tax incentive and subsidies preclude some alternatives. For instance, solid waste as a fuel for electrical generation is more expensive due possibly to subsidies given to more conventional forms of generation. Some companies are often given preference through depletion allowances and tax write-offs which depress actual cost and make comparisons of true cost of alternatives difficult.

A wider perspective is required to consider all possible alternatives under true cost which includes considerations such as resources depletion, energy requirements, capital cost, and environmental cost.

9.4 APPLICATION TO NORTH PICKERING

9.4.1. General

At this time due to the relatively recent acknowledgement that a potential energy crisis presently exists, the uncertainty as to its extent and duration, and the policy that Government will follow regarding allocation of Canada's energy resources, it is very difficult to comment specifically on energy use in the utilities, services and communications field for North Pickering. In order to comment specifically on many areas, it is necessary to evaluate the total energy perspective, both within and outside the proposed community and for other areas such as transportation, building construction and legislation.

The following comments on the application to North Pickering of various energy conservation measures related to utilities, services and communications is preliminary and as yet incomplete. The whole subject must be viewed and evaluated on a wider basis at a later date and recommendations made on the total energy concept for the project.

9.4.2 Specific Applications

Should it be decided that North Pickering would not be totally serviced with piped natural gas or oil distribution systems, the use of heat pumps for space heating and air conditioning should be closely evaluated. In this climate, it is probable that supplemental heating systems would be required for the coldest days in order to efficiently size the heat pumps.

Should incineration of solid waste be selected as the most feasible method of solid waste reduction prior to disposal,consideration should be given to recovery of energy intensive materials such as aluminum, steel,and copper. The incinerator could be designed in conjunction with a combined electrical generating-district heating system which could utilize waste or bleed steam from the electrical turbines for district heating purposes.

The pyrolysis process is potentially a more feasible method than incineration for the recovery of energy from solid wastes and the system also lends itself to the reclamation of energy intensive materials.

Consideration should be given in the future to utilizing waste heat from nearby power generating stations. Us of waste heat for district heating or cooling systems would mean sacrificing the power generating capacity of such stations in order to provide water of sufficiently high temperature.

Major complexes within the community could be urged to consider the feasibility of on-site electric generating plants utilizing solid waste products for fuel substitution and designed such that the waste heat can be utilized for space heating and air conditioning .

All equipment or systems, both public and private requiring significant fuel or electrical power, could be reviewed and approved by the appropriate authorities to ensure they meet minimum energy efficiency requirements.

Replacement of incandescent lighting with fluorescent lighting with use where feasible, of mercury vapour or sodium lamps is recommended.

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SYSTEMS LOCATION

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10.0 SYSTEMS LOCATION

10.1 INTRODUCTION

This paper deals with the macro and micro viewpoints of transportation and utility systems. Transportation systems are confined to road and rail systems, while utility systems cover standard municipal utilities such as water and sewers and other utilities such as electricity, telephone, gas, oil and community antennae television (cable television).

These systems are reviewed as to current practice in systems location, any innovative practices and the applicability and recommended practice for the North Pickering Community.

10.2 CURRENT PRACTICE

10.2.1 Transportation Systems Location

Road and rail corridors on a macro scale have been established historically through the need to transport goods and people between major urban centres. While few new rail corridors have emerged since the initial system was established nationwide in Canada, new road systems continue to be planned to service the needs of new communities.

On a micro scale, in Ontario and more particularly in the Metropolitan Toronto area, commuter rail systems and rapid transit systems are being planned and constructed with locations being dictated by availability of rights-of-way, use of existing facilities, or new underground construction. Road systems location on a micro scale is established in the planning process of new communities.

10.2.2 Utility Systems Location

On a macro scale, utility systems such as hydro-electric transmission lines and gas and oil transmission pipelines, have been established where rights-of-way could be obtained with the least disruption to existing communities. More recently, environmental and aesthetic impacts have been studied to evaluate projects and establish systems location.

On a micro scale, utility systems such as local electricity lines, gas, telephone, oil, cable television and water and sewer lines have traditionally been located within the municipally-

controlled road allowances or on easements controlled by the owner of the utility. The following is a more detailed review of the current practice of installation and location.

a) Electrical Servicing - The standards of servicing of residential areas with electricity depends upon the locally adopted standards of the electrical utility as to underground or overhead installation. Installation in the yard on an easement or on the road allowance at the front of the house are both practised. However, front yard installation on the road allowance is favoured, permitting joint use with street lighting and common trench construction with some other utilities.

b) Telephone and Cable Television - Front or rear yard installation of these utilities is practised, with the front yard, within the road allowance, being generally preferred. Both underground and overhead installations are considered. However, underground installation is most commonly used in new residential construction.

c) Gas and Oil - These utilities are usually installed within the road allowance, at the front of the lot. Local oil service lines are not too common in new residential areas.

d) Municipal Utilities - Water, storm and sanitary services are usually located within the road allowance, or adjacent to the road allowance on an easement. Installation of these services at the rear of a lot is usually limited to cases where planning has dictated that rear laneways are included in the overall concept.

10.2.3 Common Corridors

Due to the ever-increasing scarcity of inexpensive real estate, and to lessen aesthetic and other environmental impacts, consideration has to be given to the use of common systems corridors. On a macro scale, major systems could be located in common corridors 150 to 300 feet in width. However, the inclusion of major highways in such a corridor has not been widely accepted. Sewage works, which depend upon gravity flow, might also be precluded, since it is not generally feasible that corridors conform to the topography necessary for gravity flow.

On a micro scale, the municipally-controlled road allowance or laneway is presently being used as a common corridor, achieving maximum use of the space allocated. Also on the micro scale, the most efficient use of available space is provided in the utility tunnel installation. Utility tunnels usually are installed on the road allowance or laneway and more commonly in

dense urban areas where street excavations cause great expense and interruption to traffic.

10.2.4 Common Trench Installation

At the present time, underground installations of electricity lines, telephone, and cable television in a common trench with random separation is being practised. The installation of other utilities such as gas, oil and water services lines in common trenches has been suggested but no documentation has been noted. In their brief to the Scarborough Planning Board, the Utilities Co-ordinating Committee stated that crowding of utilities due to lessened road allowance widths would present construction and maintenance problems. These would arise primarily from excavation for maintenance by inexperienced workman without due regard for all the various utilities in the common trench.

10.2.5 Utility Tunnels

Utility tunnels in some form have a history of over one hundred years in Europe. In London, England, portions of the system were constructed in 1859, and utility lines were suspended in the existing Paris "great sewer" system at approximatley the same time. However, not until recently have any additional large scale systems been planned and installed. On the North American continent, installations have largely been limited to college campuses and institutions, with a few special purpose installations, such as tunnels under rivers and far northern installation to prevent freezing of water and sewer lines.

Most utility tunnel installations are found in high density urban districts where traffic congestion is a critical factor, utility services are dense, and total cost of utility service trench excavation is expensive. Compatibility among utilities is a major problem, with gas explosions and damage to other systems, possible water leaks and rupture, potential electric and electromagnetic interference problems between electric power and communications systems, and thermal effects on other systems resulting from heat losses from heating systems, all being cited. Security and access control can also be problems.

In general, sewerage systems are not installed in utility tunnels unless special conditions such as northern installation requires it. Gas systems have been installed in utility tunnels and it seems that one disaster precipitates abandonment of the idea. Considerable apprehension exists about the inclusion of gas mains in tunnels with other utilities. The expansion of

works when utility tunnels are used can be extremely difficult if the provision for expansion was not planned and built into the initial installation.

In summary, utility tunnels have been used in areas of high density and where urban reconstruction programmes have taken place.

10.2.6 Maintenance Problems Related to Systems Location

On a micro scale, utilities located within the road allowance or in a laneway are preferred by the maintaining body. Underground installation rather than overhead is recommended for better reliability and improved safety. In dense urban areas with a multitude of utilities and heavy traffic a utility tunnel system is ideal if a maintenance problem occurs on a utility within the tunnel. However, branch lines have to be excavated to be repaired, causing traffic disruption.

10.2.7 Administration

Utilities administration has traditionally been the responsibility of the owner of the utility. On a micro scale, local area coordinating committees are active to solve mutual problems, usually of location of facilities. There is no overall administrative body to dictate as to standards for location of utilities. However, the Ontario Housing Advisory Committee has recently adopted guidelines in this area that may affect future utility locations within residential areas.

10.2.8 Restrictions

On a macro scale, the transportation and utility systems of the future will be controlled as to their aesthetic and their environmental impact. On the micro scale, in residential areas, new construction practices will be required to overcome the restrictions of decreased road allowances and congested utility installations.

Future major traffic delays due to maintenance works may not be tolerable in congested urban areas. If this is the case, new utility installations may have to be in utility tunnels or in separate corridors, to minimize these delays.

10.3 INNOVATIONS

10.3.1 General

In looking at innovative practices of systems location on a macro scale, the most innovative practice would be the multiple use utility corridor. At a micro level, innovative practices involve common trench installation and utility tunnel installation in dense urban areas.

10.3.2 Utility Corridors

The placing of transmission lines for electricity, gas, telephone and water in a common corridor with highway or rail lines is feasible technically. The advantages associated with the corridor concept are:

-conservation of space
-better public reaction,
-less impact on the environment through concentration of aerial plant in limited areas,
-possible savings in rights-of-way costs,
-avoidance of fragmentation of land.

The disadvantages associated with the corridor concept, although manageable, might create problems in the functioning of the common utility corridor. These are:

-necessity for close co-ordination in construction and maintenance,
-administrative problems in ownership and operations
-lack of coincidence in routing,
-mutual interference,
-hazard of damage by maintenance equipment to other underground utilities.

As well as its primary use, consideration should be given to the usage of utility corridors for passive recreational activities.

10.3.3 Common Trench Installation and Utility Tunnels

The major emphasis of both of these ideas is to bring together into one area, utilities which have traditionally been separated. Whether this takes place in one trench or in a tunnel beneath the ground, does not matter, since the compatibility of utilities is the prime consideration of co-existence. It would probably be advisable if water mains, sewers and gas mains were separated. Common space exposure presents the following potential problems:

-flooding possibility due to rupture of water or sewer pipes.
-heat damage from steam pipes.
-adverse inductive and magnetic effects on telephone transmission from electricity lines.

-despite precautions, possible explosions from the interaction between power and gas transmission lines.
-accidental damage to facilities from workmen involved in maintenance work.
-exposure of facilities to tampering in utility tunnels.
-difficulty in establishing coincident routing.

The advantages of utility tunnels:

-access to plant without traffic disruption.
-availability to trunk facilities at all points on route.
-all-year availability.

10.3.4 Administration

A concerted effort to standardize locations of systems would be appropriate in future planning. This would mainly apply to the micro systems, within residential areas. In Ontario, a province-wide standard would be helpful, administered by a provincial utilities co-ordinating committee.

10.4 APPLICATION TO NORTH PICKERING

Assuming that the macro systems locations have been established outside the community, the micro systems locations are of immediate concern. Depending upon the planning concepts adopted, it would appear that for residential areas the multiple use, municipally-controlled road allowance of laneway should be utilized for the installation of utilities. Ease of access for maintenance should be a prime consideration as well as minimizing disruption to traffic.

Utility tunnels could have applicability in dense urban areas where the economic justify such installations. The problems of ownership and access control would also have to be overcome.

In general, the present day conventional standards with applicable innovations would appear to be the most suitable practice for systems location for the North Pickering Community.

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SYSTEMS ADMINISTRATION

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11.0 SYSTEMS ADMINISTRATION

11.1 INTRODUCTION

The services, utilities, and communication systems normally associated with a large community are provided, maintained, and charged for by a variety of private and public corporations. It has been observed that often there appears to be duplication of effort, and some lack of co-ordination, resulting in inefficiency and loss of economy.

The local municipality generally provides some degree of co-ordination by allocating locations within public rights-of-way for the installation of the services. In some areas, co-ordinating committees have been established to improve communications and co-operation between utilities. Most services are subject to the regulations of one or more provincial or federal agencies.

11.2 CURRENT PRACTICE

At the present time in Ontario, services, utilities and communications are provided by several different methods.

11.2.1 Water Supply

The supply and distribution of water is generally a municipal responsibility, although there are a great number of individual private systems and in some areas privately owned communal systems are operating. Municipal control may be administered by the corporation or by a separate public utilities commission or water board. In some cases, the distributing agency also provides treatment and storage and major transmission facilities; in other cases, these functions are handled by a regional authority or the province who then sell water wholesale to the distributor.

Large water users are charged on a metered consumption. Small consumers are sometimes charged a flat rate but common practice is to meter all users, except those in multiple family units. The use of individual meters generally results in lower water consumption.

In some areas the water and electric service share a common administration and bills are processed together.

11.2.2 Sewage Collection and Disposal

The collection of sewage has traditionally been a municipal

responsibility. Treatment and disposal have been provided both locally and regionally depending on the areas served. New regions are assuming responsibility for treatment works. There are several methods of paying for sewage service. In areas where the sewers have been paid for, operating costs are borne by general taxes. In areas where sewers are installed under local improvement programmes, those served must assist in the payment by a special levy. Sewage treatment may be paid from general taxes; as a surcharge on the water bill; by special assessment; or by metered flow as is sometimes the case for industries.

11.2.3 Storm Drainage

Storm drainage work, either sewers or open channels are predominantly a local responsibility. The facilities are usually provided at the time of construction of roads. Developers and hence homeowners pay for local systems, Ministry of Transportation and Communications share in the cost of some road drainage systems, and municipalities, regions and provincial authorities all participate in the construction or improvement to major drainage channels or natural streams. Operating costs are usually paid from a general maintenance budget and specifically charged to users.

11.2.4 Solid Waste Collection and Disposal

Solid waste collection has traditionally been a local responsibility, usually municipally provided and paid for by property taxes and sometimes privately provided on a contract basis. Final disposal has in the past been provided by the waste collectors but is more recently becoming a regional responsibility.

11.2.5 Communication Systems

Communication services, in the form of the telephone system and cable TV are also provided by private companies and users are billed separately by each company. There is reasonably good co-operation among the telephone, cable TV and electric supply organizations. The telephone company often installs the TV coaxial cable in the telephone cable trench or provides for its installation on telephone pole lines. The telephone company will charge for this service usually by a leasing agreement. It is also common for telephone and electric cables to be installed in one trench. Telephone and hydro poles are also shared where practical.

11.2.6 Electrical Service

Electrical service in Ontario is provided either by a municipal

utility that generates and distributes its own power, by a municipal utility that buys power from Ontario Hydro and distributes it locally, or by Ontario Hydro directly. Users of electrical energy pay either for the total energy consumed (small users), or for the peak demand rate (large users), or a combination of both. The only occasion when the consumer pays directly for capital costs is in those instances where the cost of installation of a new service is assessed against a land developer and subsequently added to the cost of a new home.

Electric commissions are often administered independently of other services and sometimes in conjunction with the water service.

11.2.7 Gas and Oil Systems

Gas and oil service, when provided, is usually by private companies. They are administered independently of other services with only co-ordination of location being provided by the municipality. Metering and billing is handled by the individual company.

11.3 INNOVATIONS

There would appear to be opportunities for innovation or at least improvements in the overall operation and administration of the many services provided to a community. Such innovations should have as their objective, improved service, co-ordination, economy, efficiency and safety.

Several technical innovations have been developed in the areas of meter reading and billing. The telephone company has developed a method of remote automatic meter reading via existing telephone lines. A test system is scheduled for operation in the Borough of North York during 1974.

Ontario Hydro have investigated the practicability of locating all meters at the transformer and transmitting meter readings to a central location via telephone lines, cable TV lines or even along their own neutral cable. They strongly favour remote, automatic meter reading and in the near future will provide their own system if a combined meter reading system is not developed.

The use of the computer is now very common for preparing bills and could be readily combined with the remote meter reading system to provide full automation.

The computer can also be used for operation and maintenance of utility systems. All information relating to design, location, state of operation and records of maintenance can be stored in a computer.

One current complication regarding combining the accounting and billing procedures for several services is the substantial investment in and commitment to individual computer systems in the separate organizations.

The topic of systems administration and services location is the subject of on-going discussions by the North Pickering Project Utilities Co-ordinating Committee, Sub-Committee on Technological Innovation. Goals and objectives have been prepared and evaluated for a "multi-utility co-ordinating group". Of primary importance are improvements that will result in expanded service, lower first cost and more economical operation.

Capital cost reductions might be achieved by co-ordination of utility design and installation to minimize land requirements and reduce road allowance widths; greater joint use of public land by compatible utilities; the use of common trenches for mains, branches and crossings; and including land cost when evaluating alternative layouts.

Operating costs might be reduced through the development of a multi-utility co-ordinating group. There are several ideas which in theory should save money, but are neither workable nor desirable. Personnel generally cannot be shared because they are specially trained for each utility. Vehicles often are specially equipped and thus not readily flexible. Also, vehicles are used for utility identification and advertising.

Facilities that could be profitably shared include administration offices, computer and billing services and storage and maintenance yards.

Another reason for better co-ordination of utilities is to provide expanded and improved service. A central office would improve service to the public. Computerized meter reading and billing would improve accuracy and reduce complaints.

A comprehensive inter-utility radio communications network would improve maintenance service.

Comprehensive proposals have been considered to deal with the problems of providing and co-ordinating the various municipal services. They range from the establishment of a multi-utility co-ordinating agency to a municipal utility commission to a super-utility.

11.3.1 Multi-Utility Co-ordinating Agency

Such an agency would be an extension of the co-ordinating committee idea now being tried. The agency would be funded by all the utility and service companies both private and municipal and would provide co-ordination, planning and inter-utility arbitration. Other services could include common meter reading and billing.

11.3.2 Municipal Utility

Under this concept, one municipally-owned utility would be established to market and distribute all services to the community. Similar to local electric utility commissions, this new utility would purchase bulk service from the established private and public service and utility companies.

This would offer all the advantages of a co-ordinating agency and should also be more efficient since all municipal services including transportation, would be governed by the local administraiton.

Initially, the expertise associated with each utility organization would not be available to the municipal utility and progress and service would suffer.

11.3.3 Super-Utility

A super-utility would offer the advantages of the municipal utility but would be a co-operative effort of all the service and utility operators. The advantages of a super-utility would be:

- Economy of operation because of shared facilities.
- Expanded and improved services because of integration of operations.
- Decrease of waste of raw materials and natural resources through reconversion and reuse operations.
- Balance of needs with available resources.
- Minimum disruption to the citizen's way of life because of co-ordination.

11.4 APPLICATION TO NORTH PICKERING

At the present time in North Pickering there exists no service or utility distribution systems of any extent. This presents an opportunity for the establishment of new concepts in administration, perhaps a multi-utility co-ordinating agency.

A municipal utility is not considered feasible for a community of this size because of the very great start-up costs and the difficulty of establishing the requisite expertise in a short time.

A co-ordinating agency should be established as early as possible to begin long range planning. This group could further investigate the feasibility of establishing a super-utility for implementation when the development commences.

Common remote meter reading should be provided as well as combined billing where practical.

With the opportunities available and the advantages of co-ordination, sharing, efficiency, economy and safety, it is obvious that the various services, utilities, and communication organizations must join forces at an early stage to build a better community.

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This report was prepared as background material in the planning of North Pickering Planning Area and does not necessarily constitute a recommendation of the North Pickering Project nor approval of the Government of Ontario.

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